# The Engineer.

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## The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.


The Main Engines of the Motor Liner Aorangi (with a Two-page Drawing).

The British Steam Railway Locomotive from 1825 to 1924—No. III.

Water Supply in 1924.

The Friction of Pistons and Piston Rings.

Electric Locomotives for Spain.

Fuel and the Future.

New Type of 15-ton Side-Tipping Wagons.

3-Wire Direct Current Distribution Networks.


### PUBLIC NOTICES

**The Director - General,** India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES—

1. ZINC CAKE, 99.8 Per Cent. Purity, Cwts. 4000.
2. BATTERY of DROP STAMPS, Electric Motor Driven.

Tenders due on the 23rd January, 1925, for No. 1, and on the 27th January, 1925, for No. 2.
Tender forms obtainable from above. 8084

**Assistant Engineers (2)** REQUIRED by the PUBLIC WORKS DEPARTMENT, FEDERATED MALAY STATES, for four years' service, with possible permanency. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present in Malaya. Free passages provided. Candidates, age 28 to 35, preferably unmarried, must have received a good theoretical training, preferably at a University or an Engineering College recognised by the Institution of Civil Engineers, or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. Possession of an engineering or science degree preferred. In addition to pupilage must have had at least one year's practical experience in the design and execution of works of some considerable magnitude. A knowledge of modern road making and maintenance is desirable.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/13,324. 8032

**Assistant Engineers (4)** REQUIRED for the GOLD COAST GOVERNMENT Central Province Railway Construction, for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £750 a year by annual increments of £30. Field allowance of £90 a year whilst carrying out duties in the Colony. Free passages and liberal leave on full salary. Candidates, not over 40 years of age, must be fully trained civil engineers and be proficient in the use of the transit and level. Must have ability to do ordinary draughting and compiling estimates, and be able to set out work and generally supervise erection of concrete and steel work. One of the four Engineers required must be a proficient draughtsman.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/12,449. 8079

**Assistants (Two) Required** by the GOVERNMENT of CEYLON, for service in the Architectural Office of the PUBLIC WORKS DEPARTMENT for a period of three years, with possible permanency. Salary £500, rising to £540 a year by annual increments of £30, and thence (if appointment is made permanent) to £960 a year, payable locally in rupees at the Government rate of exchange of 15 rupees to the £. Free passages. Candidates, preferably unmarried, aged 26-30, must have passed the examination for Associate Membership of the R.I.B.A. or for the Membership of the Society of Architects, and have had good general architectural experience. Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,945. 8081

**Civil Engineers (2) Required** by the GOVERNMENT of SIERRA LEONE for the PUBLIC WORKS DEPARTMENT, for two tours of from 12 to 18 months' service, with possible extension. Salary £480 for the first three years of service and then £510, rising to £720 a year by annual increments of £30, and thence to £920 a year by annual increments of £40. Free passages and quarters and liberal leave on full salary. Candidates, aged 25 to 35, must have served articles with a corporate member of the Institution of Civil Engineers and have passed the examination qualifying for A.M.I.C.E. or hold equivalent professional qualifications. Must be good draughtsmen, capable of designing and carrying out buildings, bridges and other engineering structures and of taking out quantities and preparing detailed plans and estimates. Must be competent to execute surveys and to lay out and construct roads and have had experience as civil engineers on the construction of roads, buildings, and other public works.—Apply at once, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,305. 8078

**Draughtsman Required** by the GOVERNMENT of NIGERIA, for two tours of not less than 12 nor more than 18 months' service. Free passages and quarters and liberal leave on full salary. Outfit allowance of £60 on first appointment. Salary £600, rising by annual increments of £30 to £720 and thence by annual increments of £40 to £920 a year. Candidates, aged 25 to 35, should be A.R.I.B.A. and have had experience of hospital and general building work and have had good experience of quantities.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/13,305. 8082

**Executive Engineer Required** by the GOVERNMENT of SIERRA LEONE in the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' continuous residential service. Salary £600 a year. Free quarters and passages and liberal leave on full salary. Candidates, aged 28-35, should have served articles with a member of the Royal Institute of British Architects and have passed the examination qualifying for Associate Membership of that Institute, or possess the diploma of some recognised college which is accepted by that Institute as exempting candidates from taking the examination of the Institute. Must be first-class draughtsman, capable of designing and carrying out buildings, taking out quantities, preparing details and specifications, and must be competent to execute building surveys, set out buildings and lay out roads.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,190. 8021

### PUBLIC NOTICES

**The Government of India** REQUIRE an INSPECTOR OF CASTINGS for the Indian Stores Department.

Five years' agreement in first instance. Salary at the rate of Rs. 500-50-750 per mensem, with certain allowances. Free first class passage to India. Provident Fund.

Qualifications: Age 25-35 years; apprenticeship with well-known firm of Pipe Founders; sound knowledge of Moulding generally; thorough knowledge of Inspection of Cast Iron Pipes, and especially of those made under British Standard conditions essential; should have held responsible position in up-to-date works.

Prospective candidates should obtain further particulars from the SECRETARY to the HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 31st January, 1925. 8050

**Loughborough College,** LOUGHBOROUGH, LEICESTERSHIRE.
Dr. H. SCHOFIELD, M.B.E., Principal.

DEPARTMENT OF AUTOMOBILE ENGINEERING.

APPLICATIONS are INVITED for the POSITION of HEAD of the AUTOMOBILE ENGINEERING DEPARTMENT. Candidates should be Graduates of a British University, and have had practical experience in the Design and Manufacture of Automobiles. The scale of salary ranges from £450 to £650 by annual increments of £25, and the commencing salary will depend upon the qualifications and experience of the applicant.

All applications, with copies of not more than three recent testimonials, should be forwarded before January 28th to the REGISTRAR, from whom any further particulars may be obtained. 8070

**Basingstoke Corporation Electricity Department.**

TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION of:—
ONE 600 B.H.P. VERTICAL CYLINDER HEAVY OIL ENGINE and DIRECT-COUPLED DYNAMO.

Specifications, general conditions and form of Tender may be obtained on application to the undersigned on payment of a deposit of £2, which amount will be returned on receipt of a bona fide Tender.

Duplicate copies of specification, &c., may be had on payment of 5s. per copy, not returnable.

Sealed Tenders, marked "Tender for Generating Plant," and addressed to the Chairman of the Electricity Committee, must be delivered at the Electricity Works not later than Noon on Friday, January 30th, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

F. SWARBRICK, A.M.I.E.E., A.M.I. Mech. E.,
Borough Electrical Engineer.
Electricity Works, Basingstoke. 8033

**City of Birmingham Water Department.**
BARTLEY RESERVOIR.
EXTENSION OF TIME FOR SUBMISSION OF TENDERS.

NOTICE IS HEREBY GIVEN that the TIME for the DELIVERY of TENDERS for the above WORK, advertised in this paper on 26th December, 1924, and 2nd January, 1925, has been EXTENDED from Noon on Monday, 26th January, 1925, to Noon on MONDAY, 9th FEBRUARY, 1925.

J. H. BROADLEY,
Secretary.
Water Department, Council House, Edmund-street, Birmingham, 8th January, 1925. 8028

### PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

**Notice is Hereby Given that** EMILE PIQUEREZ, Manufacturer, of St. Ursanne, Switzerland, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 149,609 granted to Frank Drew Winkley for "An Improved Lubricating System."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) issued on the 31st December, 1924.

Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.
Stanley, Popplewell and Co., 88, Chancery-lane, London, W.C. 2, Patent Agents for the Applicant. 8076

**County of London.**
REPAVING OF WESTMINSTER BRIDGE.

The London County Council invites TENDERS for the REPAVING with WOOD BLOCKS, and subsequent Maintenance, of the CARRIAGEWAY of WESTMINSTER BRIDGE.

Persons desiring to Tender may obtain the form of Tender and contract, specification and bill of quantities on application to the Chief Engineer, at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £3 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall send in a bona fide Tender, which is not subsequently withdrawn. Full particulars of the work man be obtained on personal application, and the contract documents may be inspected before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 2nd February, 1925, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
8062 Clerk of the London County Council.

**Southampton Corporation WATERWORKS.**
OTTERBOURNE PUMPING STATION.
TO PUMPING ENGINE MANUFACTURERS.

The Corporation invite TENDERS for the MANUFACTURE, DELIVERY, ERECTION, SETTING to WORK, TESTING, and MAINTAINING for a period of six (6) months of 2 TRIPLE-EXPANSION PUMPING ENGINES, WELL and FORCE PUMPS, &c., each set to be of a capacity of 6 million gallons per day of 24 hours against a head of 250ft.

Plan of existing and proposed engine-houses, &c., with specification, conditions of contract and form of Tender, may be obtained from Mr. E. C. Rodda, Waterworks Engineer, 21, Shirley-road, Southampton, upon production of the Borough Treasurer's receipt for a deposit of £5 5s.

Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders.

Sealed Tenders, endorsed "Tenders for Pumping Plant, Otterbourne Waterworks," must be delivered at the Town Clerk's office on or before the 16th February, 1925.

No pledge is given to accept the lowest or any Tender.

R. B. LINTHORNE,
Town Clerk.
6th January, 1925. 7998

**The Great Indian Peninsula** RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for:—

1. STEEL WORK for BRIDGES .... Fee £1
2. BIB COCK, &c. .... ,, 2s. 6d.

Tenders are due by 11 a.m. on 27th January, 1925. Tender forms obtainable at above address. Fees not returnable. 8091

### PUBLIC NOTICES

**Tees Valley Water Board.**
NUNTHORPE SUPPLY, 1925.
CONTRACT NO. 2.
PUMPING MACHINERY.
TO CONTRACTORS.

The Tees Valley Water Board are prepared to receive TENDERS from competent persons willing to enter into a contract for the SUPPLY of PUMPING MACHINERY and ERECTION thereof at their Pumping Station in Normanby-road, South Bank, near Middlesbrough.

The drawings may be seen and copies of the specifications and bills of particulars obtained at the office of the undersigned, Municipal Buildings, Middlesbrough, and of the Engineers, Messrs. James Mansergh and Sons, 5, Victoria street, Westminster, London, S.W. 1, on and after Tuesday, the 20th instant, on deposit of £2, which will be returned after the receipt of a bona fide Tender, with the bills of particulars fully priced out. Early application for particulars is desirable, as only a limited number will be given out.

Sealed Tenders, endorsed "Pumping Machinery," are to be delivered at my office at or before Noon on Thursday, the 5th day of February, 1925.

The Board do not bind themselves to accept the lowest or any Tender.

(Signed) THOS. S. CLAVERT,
Clerk to the Board.
Water Board Offices, Middlesbrough, 16th January, 1925. 8104

**The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.**

The Directors are prepared to receive TENDERS for:—
242 PAIRS WHEELS and AXLES, complete with SANDBERG SORBITIC TYRES, for 4-Wheeled Covered and Open Goods Wagons, Metre Gauge, in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea (£1 1s.), which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 3rd February, 1925, and marked "Tender for Wheels and Axles."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road, Westminster, S.W. 1,
19th January, 1925. 8073

**The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.**

The Directors are prepared to receive TENDERS for:—
CAST IRON SLEEPER POTS for B.S. 90 lb. B.H. RAILS, comprising
93,750 Cast Iron Sleeper Pots, Right Hand;
6250 Do. Do., Left Hand, BROAD GAUGE,
Total approximate weight equals 5000 tons, in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea (£1 1s.), which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 3rd February, 1925, and marked "Tender for Sleeper Pots."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road, Westminster, S.W. 1,
14th January, 1925. 8086

**The Rural District Council of CHELMSFORD.**
TENDER FOR OIL ENGINE.

The above-named Council invite TENDERS for the SUPPLY and ERECTION at their Waterworks at Danbury of a COLD STARTING CRUDE OIL ENGINE of not less than 10 B.H.P. working load. Particulars may be obtained from the Council's Engineer, Waterloo-lane, Chelmsford.

Sealed Tenders, endorsed "Oil Engine," to be delivered to the undersigned not later than Monday, the 26th January, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

ARTHUR S. DUFFIELD,
Clerk.
96, High-street, Chelmsford, 7th January, 1925. 8039

**Youghal (Co. Cork) Urban DISTRICT COUNCIL.**

TENDERS are INVITED for the SUPPLY of about 7 Miles of 8in. CAST IRON WATER MAINS. Specification and form of Tender will be supplied by the undersigned on payment of Two Guineas, which will be refunded on receipt of a bona fide Tender.

B. O'FLYNN, B.E.,
Engineer.
Trinity Chambers, South Mall, Cork. 8067


PUBLIC NOTICES (continued) Page 2.



SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 4.
MISCELLANEOUS, Page 3.
PARTNERSHIPS, Page 2.
AGENCIES, Page 4.
FOR SALE, Pages 4, 86 and 92.
AUCTIONS, Pages 3 and 92.
BUSINESSES and PREMISES (For Sale, etc.), Page 3.
MACHINERY, &c., WANTED, Page 2.
WORK WANTED, Page 86.



*For Advertisement Rates see Page 79, Col. 1.*



INDEX TO ADVERTISEMENTS, Page 91.

## PUBLIC NOTICES

**The South Indian Railway Company**, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. STRUCTURAL STEEL WORK (Yard Plant).
2. STEEL WORK for BRIDGES (T.D.D. Railway).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Structural Steel Work (Yard Plant)" or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 13th March, 1925.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
14th January, 1925. 8092

**Egyptian State Railways, Telegraphs and Telephones.**

"THE EGYPTIAN RAILWAY ADVERTISER."

A weekly publication in Arabic, English and French.

Subscription : 50 Egyptian Piastres (about 10 shillings) yearly.

An organ of the Egyptian State Railways, Telegraphs and Telephones, containing information of interest to Contractors and Suppliers of Materials and Stores used by the Administration.

For particulars apply to PUBLICITY SECTION, Egyptian State Railways, Cairo (Egypt). 8085

## SITUATIONS OPEN

WANTED, an Enterprising and Resourceful SALESMAN for Engineering Specialities, to travel North of Scotland.—Apply, with full records, age, where stationed, where travelled, approximate turnover last three years, and approximate amount earned per annum, to RONALD TRIST and CO., Ltd., 12, Clipstone-street, Gt. Portland-street, W. 8042 A

WANTED, ENGINEER, with General Experience (about 27), as Assistant to Works Manager. State age, education, experience, and salary required. —Address, P130, The Engineer Office. P130 A

WANTED, for Engineering Works Employing about 150 men at Leicester, COMMERCIAL MANAGER, thoroughly experienced in all departments ; must be capable to Control Drawing-office, Sales Office and Correspondence, and have sound Works Experience. Preference to man experienced in Road and Quarry Plant, Elevating, Conveying and Crushing Machinery. State fully experience, where and when gained, age, salary required.—Address, 8031, The Engineer Office. 8031 A

A FIRM of EXPORT ENGINEERS, Handling the Export of Motor Cars, Lorries and Accessories, have a VACANCY on their staff for an ASSISTANT ENGINEER, having a thorough knowledge of such business. Previous experience of a similar nature essential. Salary £400 per annum.—Reply, Box A.E. 254, c.o. Dawson's Advertising Agency, 118, Cannon-street, London, E.C. 4. 8038 A

ARTICLED PUPIL.—A CHARTERED CIVIL ENGINEER has VACANCY for well-educated Youth as ARTICLED PUPIL ; good practical and theoretical training. Interesting works in progress. Premium.—Address, 8061, The Engineer Office. 8061 A

ERECTING ENGINEER, with Experience in Aerial Ropeways. Give full particulars of experience with salary expected.—Address, 8045, The Engineer Office. 8045 A

ELECTRIC TRACTION ENGINEER. — WANTED by large Manufacturing Firm, ENGINEER with Specialised Knowledge of Design and Manufacture of Electric Railway Motors ; must have ability and practical experience in Determination of Motor Requirements for specific electric traction projects. Good remuneration and excellent prospects offered. Only ambitious and progressive men with practical experience need apply. State full particulars, salary required and earliest date commence.—Address, 8052, The Engineer Office. 8052 A

ENGINEER WANTED to Supervise Construction of Overhead Transmission Lines in England. Previous experience essential. Send full particulars, age, experience, references, and salary. VACANCY also for ASSISTANT.—Write, Box 280, Sell's Advertising Offices, Fleet-street, E.C. 4. 8049 A

ENGINEERING JOURNALIST REQUIRED for Publicity Staff of Large Engineering Firm. Experienced in preparation of Press Articles, preparation of Catalogues and Sales Leaflets. State age, salary required, &c.—Address, 8100, The Engineer Office. 8100 A

FOUNDRY MANAGER REQUIRED for Iron and Steel Foundry ; must have had a thorough practical training and be a good disciplinarian, up-to-date knowledge of Moulding Machines and expert experience on Cupola Practice and Mixing by Analysis. A knowledge of Semi-steel, also Electric Steel Furnaces desirable.—Address in confidence, stating experience, references, and wages required, 8071, The Engineer Office. 8071 A

HEATING and GENERAL ENGINEERS (Old-established business) REQUIRE competent REPRESENTATIVE.—Address, stating qualifications, age, and terms required, P109, The Engineer Office. P109 A

JUNIOR RATEFIXER and PLANNER REQUIRED by London Firm of Mechanical Engineers. General experience non-repetition work necessary.—Address, P107, The Engineer Office. P107 A

MELTING SHOP MANAGER.—THE CONSETT IRON CO., Ltd., is about to APPOINT a MANAGER of its New Steel Works, and is therefore ready to receive APPLICATIONS from men of experience in Acid and Basic Steel Making.—Apply, SECRETARY, Consett Iron Co., Ltd., Consett, Co. Durham, with full information as to previous experience, age, &c. &c. 7993 A

REINFORCED CONCRETE.—TWO Competent DESIGNERS REQUIRED in the provinces, with specialist experience in the design of all types of Concrete Structures.—Address in confidence, stating age, salary required, and giving a brief summary of experience, 8069, The Engineer Office. 8069 A

REQUIRED, a Capable CLERK, with Good Knowledge of the ordinary routine of a contractor's office, willing to make himself generally useful.—Address applications, with copies of testimonials and salary required, 8089, The Engineer Office. 8089 A

RESIDENT ENGINEER REQUIRED for New Sea Defence Works and Buildings ; must have had similar experience, and possess sound knowledge of Handling and Working of Large Plant ; competent to Set Out Works, Take Levels, Make Surveys, Supervise Contractor's Work, Check Quantities, Make Detail Drawings, Prepare Specifications and Supervise and Control Labour. Thorough understandong of good work essential. Salary £7 7s. per week. State age, qualifications and experience, with testimonials.—Address, 7977, The Engineer Office. 7977 A

Important Manufacturers of first-class quality

**BALL BEARINGS**

are Open to Engage Firm of good standing and with good trade connection for the Sale of their Speciality in Great Britain.

Address, with full particulars, 8053, The Engineer Office.

## SITUATIONS OPEN (continued)

RESIDENT ENGINEERS REQUIRED for Works re-organisation on the Thames, having experience with Pile Driving, Reinforced Concrete Construction, and Heavy Foundations ; to start immediately.—Address, stating age, experience and salary required, 8041, The Engineer Office. 8041 A

SALESMAN ENGINEER WANTED by Leading Continental Manufacturer for Marketing of Fuel Recorders, high-class Pyrometers, Steam and Water Meters ; must have thorough theoretical knowledge of Heat Economy Problems, and should have 2-3 years' practical experience in Boiler-house and Electric Power Station Work generally.—Address applications, with previous experience and particulars, P9995, The Engineer Office. P9995 A

WANTED, CHIEF DRAUGHTSMAN, Experienced in the design of Boiler-house Lay-outs, including all details. Only a first-rate man need apply. Good salary will be paid.—Address, 8066, The Engineer Office. 8066 A

WANTED, DRAUGHTSMAN, One who has had Previous experience on Constructional and Mechanical Work in connection with the Lay-out of Generating Stations and Sub-stations.—Address application, stating full particulars, training, past work and experience, age, commencing salary expected, date when at liberty, together with copies of recent testimonials, to 8043, The Engineer Office. 8043 A

WANTED, for Collieries in South Wales, Qualified DRAUGHTSMAN. State age, experience, and salary required.—Address, 8103, The Engineer Office 8103 A

A CONSTRUCTIONAL ENGINEERING WORKS in London REQUIRE the SERVICES of a DRAUGHTSMAN. Only those having a good experience in Structural Steel Work need apply. State age, salary, and experience.—Address, 8074, The Engineer Office. 8074 A

A PROMINENT FIRM of Steel Structural Engineers in Manchester district REQUIRE a SENIOR DRAUGHTSMAN, able to Design and Make Working Details for Buildings and Bridges. State age, full particulars of experience and salary required. —Address, 7971, The Engineer Office. 7971 A

AERONAUTICAL DRAUGHTSMAN WANTED, with good practical experience ; good salary will be paid to reliable man ; country district.—Write, stating full particulars and names of past employers, 7951, The Engineer Office. 7951 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 98, St. George's-square, London, S.W. 1. 7817 A

DRAUGHTSMAN, Experienced in Designing and detailing Steel and Timber-framed Building, &c. State age, experience, and salary required.—Write, Box D748, Lee and Nightingale, Advt. Offices, Liverpool. P106 A

DRAUGHTSMAN (for West of London District) REQUIRED, with experience in Electrical Instrument Work ; must be sound in the design of mechanical details. State age, experience, and salary required.—Address, 8087, The Engineer Office 8087 A

DRAUGHTSMAN (JUNIOR) REQUIRED IMMEDIATELY. One used to General Arrangements preferred. State fully experience, age and salary required. Apply by letter only to—

CHIEF ENGINEER,
BRITISH COTTON GROWING ASSOCIATION,
Royal Exchange,
8034 A MANCHESTER.

DRAUGHTSMAN REQUIRED for Structural Steel Work and Power Station Plant Lay-out. Applicants must have experience in the design and shop detailing of Structural Steel Work and the Lay-out of Large Modern Power Station Engine-room and Boiler-house Plant. Electrical experience is not essential.

Applications, giving full particulars of experience, age, salary required, and when duties could be commenced, to be made in writing to the CHIEF ENGINEER, North Metropolitan Electric Power Supply Co., Manor House Offices, Seven Sisters-road, Finsbury Park, N. 4. 8064 A

DRAUGHTSMAN REQUIRED, One Used to Design of Motor Vehicle Details.—Please state past experience, age, and salary required, to JOHN I. THORNYCROFT and CO., Limited, Basingstoke. 8089 A

DRAUGHTSMEN WANTED AT ONCE, with Good experience in Conveying and Structural Work and/or Reinforced Concrete.—Address, stating age, experience, and salary required, 8097, The Engineer Office. 8097 A

HEAD DRAUGHTSMAN WANTED for Midlands. Capable of Controlling Drawing-office Staff, Preparing Drawings and Quantities ; good organiser ; knowledge of High-pressure Steam Main Work and experience in Strains and Stresses of Constructional work essential.—Address, stating age, references and salary required, 8090, The Engineer Office. 8090 A

JUNIOR DRAUGHTSMAN WANTED for Engineers in North London. State experience and salary required.—Address, P9996, The Engineer Office. P9996 A

LADY TRACERS WANTED, Preferably with Aeroplane experience.—Write, stating experience, age, and salary required, to the H. G. HAWKER ENGINEERING CO., Ltd., Kingston-on-Thames. 8094 A

MECHANICAL DRAUGHTSMAN and ASSISTANT WANTED, 28 to 35 years of age, for Artesian Well and General Engineering ; Shop Experience essential. State experience fully, family, salary, when commencing (copies references only (not returnable)). Permanency to suitable man.—Address, 7952, The Engineer Office. 7952 A

REQUIRED by Consulting Engineers, Westminster, a DRAUGHTSMAN, with good experience in General Contractors' Work, Structural Work and Ferro-concrete Work ; must be good Designer and Detailer. Salary according to qualifications.—Write, Box 247, not later than 23rd January, with full particulars of career, c.o. Brown's, 30, Tothill-street, S.W. 1. 8035 A

STRUCTURAL DRAUGHTSMAN WANTED, near Manchester ; accustomed to Taking Charge when required ; expert at Supervising Details. State full particulars in confidence.—Address, 8024, The Engineer Office. 8024 A

## SITUATIONS OPEN (continued)

TWO or THREE First-class LEADING HANDS and SENIOR DRAUGHTSMEN WANTED with Aeronautical Experience.—Write, stating full particulars, salary required, and names of present and past employers.—Address, BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, near Hull. 7966 A

VACANCY for JUNIOR DRAUGHTSMAN, with knowledge of Boiler or Stoker Construction, Westminster district.—Write, stating age, experience, and salary required, 8044, The Engineer Office. 8044 A

A BRITISH FIRM of GENERAL ENGINEERS in India REQUIRE an ASSISTANT FOREMAN in their Blacksmiths' Shop. Applicants should have had experience in General Smithwork, Drop Forging and Hydraulic Press Work ; experience in the manufacture of Drums for Lancashire Boilers would be a recommendation. Must be a bachelor, age 25 to 28 years.—Write, stating age and giving full particulars of experience, to "Z. E. 642," c/o Deacon's, Leadenhall-street, E.C. 3. 8075 A

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**For continuation of Small Advertisements see page 3.**

# A Seven-Day Journal

## Awards for War Inventions.

THE third report of the Royal Commission on Awards to Inventors, issued on Monday, covers the period from August, 1922, to July, 1924, and gives details of awards, amounting to a total of some £400,000, for inventions used during the war by the British—and in a few cases by the American—forces. In the two years to which the report relates ninety-three cases were dealt with by the Commission, and 204 claims were considered by the Investigating Committee. In addition, twenty-four cases were considered by a joint Commission, including representatives of the United States, in connection with the use made of certain British inventions by the United States Government during the war. The Aircraft Manufacturing Company appears to be the principal beneficiary. For the Gnome 80 horse-power engine and Le Rhône engine it has already received £200,000 from the British Government. In conjunction with others, it now receives an additional £74,000 for the same engines. For the Gnome "monosoupape" engine it is awarded £75,000, and for the de Havilland aeroplanes £35,000. In addition, the Anglo-American Commission has awarded it £65,000 for the use of the de Havilland aeroplane designs made by the United States. Over and above the previous award, the company, in conjunction with others, thus receives the handsome sum of £249,000 in the aggregate. Messrs. Constantinesco and Haddon, in connection with the C.C. interrupter gear, have been awarded £70,000 by the British Commission and £15,000 by the Joint Commission. Other large awards are £61,000 to Vickers Limited for improvements in gun breech mechanism; £50,000 to the Bristol Aeroplane Company for the "Bristol Fighter"—with an additional £2500 from the Joint Commission; £40,000 to the Sopwith Aviation Company and a like sum to A. V. Roe and Co., Limited. Professor Sir James Henderson receives £12,500 for his improvements in optical instruments for use on oscillating platforms, and Mr. T. Graham a like sum for straight-frame ships.

## London Traffic.

THE congestion of traffic in the London streets is paralleled in so many of our large cities that anything attempted in the Metropolis by way of relieving it should have a wide interest. Following the advice tendered last week by the London Traffic Advisory Committee, the Minister of Transport has taken the step of declaring a lengthy list of important thoroughfares as being congested, thus, in effect, preventing additional vehicles being placed on such roads for public hire. While this and other steps to be taken into consideration will no doubt prevent the congestion from increasing, it still remains to deal with its reduction. In this connection, London's cross-river communication continues to be one of the main points of attack. On Monday a deputation from the Commercial Motor Users' Association laid before the Thames Bridges Committee of the London County Council some suggestions regarding the improvement of bridge facilities. The Committee strongly emphasised the view that the provision of satisfactory access to a cross-river bridge was just as important as the actual structure itself, and instanced the reconstructed Southwark Bridge as an example of the manner in which a good bridge could be deprived of much of its usefulness by a lack of sufficient means of access. The Committee did not favour the construction of the proposed St. Paul's Bridge, but recommended the acquisition of Charing Cross Station and railway bridge for use as a highway, provided connecting highway links could be constructed at each end. It also expressed approval of the proposed tunnel below the Thames from Dartford to Purfleet. It deprecated the passage of through coal traffic along railway lines within the heart of London when other alternative rail routes were available. In a paper read last week before the London Society, a New York authority gave his views on London's traffic problem. His most interesting contribution to this discussion was his emphatic condemnation of the sky-scraper type of building, which, bringing together a vast number of people on a small area, was, he held, a potent source of traffic congestion.

## The Southern Railway.

THE working of the Southern Railway has for some time been a subject of much criticism and complaint on the part of those using it. Last week a meeting was convened in London in order to hear the company's views on the situation. Sir Herbert Walker, the general manager of the system, was accompanied by the chief engineer, Mr. Szlumper, the chief mechanical engineer, Mr. Maunsell, the solicitor, Mr. Bishop, and the chief operating superintendent, Mr. Cox. Replying to the discussion, Sir Herbert admitted that the company was suffering from a lack of capital expenditure during the past ten years, and the condition of the locomotives and rolling stock left something to be desired. These things were attributable to the war. The company had to cope, too, with the changed conditions produced by the alteration in the hours of labour. Formerly, the peak load for the suburban traffic extended from 6 a.m. to 10 a.m. To-day it was restricted to 2½ to 3 hours. The evening peak load was similarly compressed. The London terminal facilities were consequently overcrowded at the rush hours. The board had decided in 1923 that electrification of the suburban lines offered the speediest solution of the difficulty. The war left the company with a depleted and defective stock of locomotives, and to make that deficiency good eighty new engines were being bought or constructed. On the South-Eastern section, full advantage of these new engines could not be taken until a programme of bridge strengthening had been completed. Over £250,000 was being spent on that work, but it would not be finished for another two years. Concluding his remarks, Sir Herbert indicated that the directors were considering the improvement of the coast route in order to give a through service between Margate and Portsmouth and beyond.

## The Port of Southampton.

IN a Journal note of December 19th last we referred to the decision of the United American Lines and the Hamburg-America Line to adopt Dover as a port of call instead of Southampton. The companies in question have now decided to revert to their former practice of calling at Southampton. The announcement of this decision has been received with much gratification by the shipping interests of the Hampshire port, for the vessels owned by the two companies will make upwards of one hundred calls per year. Some changes in itinerary are, however, to be made, and it is understood that the Albert Ballin, Deutschland, and Cleveland will call at Boulogne instead of Cherbourg on the westbound voyage, using Cherbourg and Southampton when returning eastbound. The chairman of the Southampton Harbour Board, Mr. Harry Parsons, in expressing his appreciation of the companies' decision, stated that the Harbour Board had for some time been considering the question of the charges levied upon the tenders which served vessels lying in the Cowes Roads, and, in view of the new dues, it had been decided to abolish such charges. This decision, he remarked, was not the direct result of the proposal of the American and German companies to transfer their ships to Dover, but it came as part of the continued policy of the harbour authority to assist the port and help its shipping in any way which was possible.

## The Diesel Engine Users' Association.

WE are glad to note from the secretarial statement for 1924 of the Diesel Engine Users' Association, which has just been issued, that it is the intention of the Association to continue its practice of issuing an annual report on the working costs of the heavy-oil engine installations which are under the control of members of the Association. The report for the year 1923–1924, which has just been published in its complete form, should be most valuable. Tabulated lists are given of thirty-four home stations and three stations overseas. The average total engine cost per unit generated was 0.899 pence for the home stations with 112 engines of over 22,000 kilowatts combined total capacity. The total maintenance costs over the year under consideration worked out at £0.96 per kilowatt installed. It is pointed out that these average figures do not represent results which might be obtained with plant operating under reasonably favourable conditions, since many of the stations are operating under conditions which are not conducive to obtaining the best results. With regard to fuel oils, it is proposed to consider the treatment of several grades of furnace oil with a view to their use in Diesel engines. Referring to the B.E.S.A. Specification for Fuel Oils for Heavy-Oil Engines, the opinion is expressed that some reference should be made in that specification to the sulphur content of any fuel on account of the extended use of waste-heat boilers, water-cooled exhaust pipes, silencers, &c., where high sulphur content might lead to corrosion taking place. At the end of last year there were over 400 members of the Association, forty-three new members having been added during the year. Mr. A. W. A. Chilvers was re-elected president for a second year of office, and Mr. Percy Still and Mr. Geoffrey Porter were re-elected as the joint honorary secretaries of the Association.

## German Naval Activity.

THE German Navy of to-day, though limited in size and consisting for the most part of obsolete material, appears to be maintained in a high state of efficiency. The active ships are frequently exercised in the Baltic and the North Sea, while no opportunity is missed of sending squadrons or single vessels to cruise in Scandinavian waters or the Eastern Baltic. Every ship, before being placed in commission, undergoes a thorough refit. Most of the battleships, light cruisers and torpedo boats have been re-armed with guns of a new model, and structural alterations suggested by war experience have been made. Hitherto only three or four battleships have been kept in full commission, instead of the six permissible under the Peace Treaty, but this year it is hoped to bring the fleet up to full strength in all types. The cruiser Nymphe has just been recommissioned after a lengthy refit, during which the forward part of the ship was rebuilt, the original ram bow having been replaced by a graceful clipper stem. The Berlin, a sister ship, was similarly altered a year or two ago. This last-named vessel sailed from Kiel in November on a cruise to the West Indies and Central America, and is thus showing the German naval ensign in foreign ports for the first time since the war. The new cruiser Emden, launched at Kiel on the 7th inst., was also designed with a special view to foreign service. With her centre-line battery of ten 5.9in. guns, she will be very heavily armed in proportion to her displacement. The new destroyer for which funds were appropriated last year, and which will be laid down at an early date, is reported to be of a large and powerful design.

## Engineers and Wembley.

IT became publicly known at the beginning of this week that three important bodies had decided to withdraw from participating again in the second edition of the British Empire Exhibition. These bodies are the British Engineers' Association, the British Electrical and Allied Manufacturers' Association, and the Society of Motor Manufacturers and Traders. The attitude adopted by the Motor Manufacturers is less clearly defined than that of the other bodies, but it is stated that the Society will take no part in the Exhibition, and that it is unlikely that individual member firms will do so separately. The British Engineers' Association has adopted a neutral attitude. Having taken a referendum of its members and past exhibitors, it found that a large majority was strongly against exhibiting again this year. It was therefore compelled to inform the Administrative Board of the Exhibition that it could not again undertake to organise the shipbuilding, marine, mechanical and general engineering section. Any individual firms so desiring may, however, exhibit their products without restriction on the part of the Association. The Beama has decided not to take part in the Exhibition as an association, but not to place any embargo on individual firms doing so. The organisation of the electrical section last year cost about £1,000,000, and it is doubtful whether the returns justified the cost. The decision to continue the Exhibition was unavoidably delayed. Had it been taken earlier, before the majority of the heavy exhibits were removed, the Association, it is stated, might have decided to participate again. Since Wembley without the Palace of Engineering would be deprived of much of its interest and attraction, proposals are being discussed for alternative forms of exhibition within that spacious building. It is suggested that an exhibition of housing might be arranged or one commemorating the beginnings of the steam railway.

## Extensions at the Nechells Power Station.

AT a recent meeting of the Birmingham City Council it was decided to spend a sum of £732,450 on electrical plant, the greater part of this amount being required to complete the Nechells station. Apparently the problem of dealing with the grit emitted from the chimney stacks of this station is proving a somewhat difficult one. A sum of between £14,000 and £15,000 has been spent on apparatus for dealing with the trouble, which, however, still persists, and, in addition, £35,000 have been absorbed by the use of a more expensive class of fuel. In other places where grit catchers have been installed the trouble has been overcome. The cause of the difficulties at Birmingham seems therefore to be rather a mystery. Mr. Chattock, the chief engineer, has paid a visit to America, with a view to studying the advantages of pulverised coal, and was very much impressed with what he saw. As a result, one set of boilers at the Nechells station is to be equipped for burning pulverised coal, which is expected to eliminate the grit nuisance.

## The Manufacture of Steel Houses.

LORD WEIR'S recent statement with regard to the progress being made in the design and manufacture of the new type of steel house which is associated with his firm's name, indicates that at an early date developments of considerable magnitude may be expected. Referring to the general appearance of the houses, Lord Weir remarked that the architectural proportions were pleasing to the eye, and that they had been arrived at in consultation with a well-known Scottish architect. Six different types of house are to be built, three of which are bungalow houses with three and four rooms, while the remaining three include a self-contained double-storey cottage with four rooms, and two designs for a house of the flat type which will be constructed in blocks of four and will have three and four rooms respectively. The first factory, which is now being equipped with machinery and which will be solely devoted to this work, is at Cardonald, near Glasgow. The first series of orders to be put through will include 300 houses, all of the bungalow type. These houses will be mainly built for demonstration work in Scotland and England, and it is hoped that in the early spring arrangements will be completed for establishing four further factories in different parts of the country.

# The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. III.*

PERIOD 1830–1837.

*Three Schools of Locomotive Engineers.*[1]—The division of the history of locomotive development into periods is necessarily arbitrary, since no definite lines of demarcation can be drawn, and in all instances the periods overlap. The previous periods which have been dealt with may be considered as purely experimental, and the third, upon which we are now entering, is, to a large extent, similar, but in it the locomotive as evolved by R. Stephenson and Co. gradually assumes the general form in which we know it to-day. For a few years there were three schools of locomotive engineering, one of which maintained either vertical cylinders, generally with indirect drive, or adopted Stephenson's steeply-inclined cylinders with direct drive. The boilers were of various designs, and Hackworth, its chief exponent, in his mineral engines for the Stockton and Darlington Railway, usually adhered to boilers with large internal flues. The other schools, exemplified by R. Stephenson and Bury respectively, adopted horizontal cylinders and crank axles, and their boilers were of the multitubular type. The chief differences between them lay in the framing and form of fire-box.

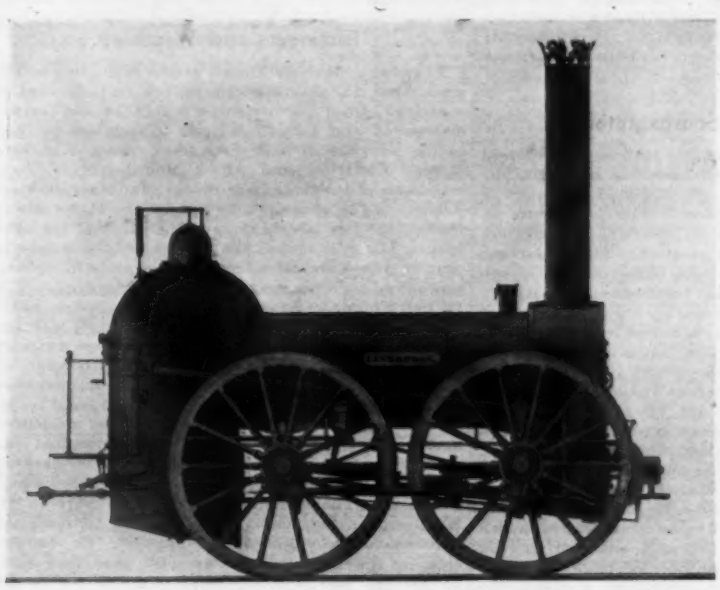


FIG. 11—BURY'S 0-4-0 ENGINE "LIVERPOOL," 1830

Claims in respect of the priority of the combination of inside horizontal cylinders and crank axle have been made on behalf of Bury, Stephenson, and Hackworth. The first engine with these characteristics was Bury and Kennedy's 0–4–0 engine Liverpool, which was tried on the Liverpool and Manchester Railway in July, 1830, the work on it having been begun in October, 1829. The second in actual service was Stephenson's Planet of September, 1830. There is no need to discuss the contention that Hackworth's designs for the Stockton and Darlington engine Globe were handed to Messrs. Stephenson, the builders of this engine, before the Planet was built. The importance of the subject lies rather in the technical characteristics of the three engines.

*Bury's* 0–4–0 *Engine Liverpool.*—This engine—Fig. 11—had 6ft. coupled wheels, then the largest in the country, and 12in. by 18in. cylinders, inclined slightly upwards to allow the piston-rods to pass underneath the leading axle. The design embodied the well-known bar framing inside the wheels, a feature which will be mentioned later when the subject of framing comes under review. Further particulars were given in THE ENGINEER of February 2nd, 1923, but it should be mentioned here that the multitubular boiler, and possibly the smoke-box also, were subsequent replacements made when the engine was reconstructed a few months after its first appearance. A drawing of the Liverpool, published in Bourne's "Steam Engine," shows that the cylinders were not entirely enclosed within the smoke-box, as was the case in Stephenson's Planet and in Bury's later engines. The later boiler mentioned above also included Bury's well-known D-shaped fire-box with hemispherical top and casing. It must be conceded that Bury's engine, most of the details of which were due to James Kennedy, showed a remarkable advance in locomotive design.

*Stephenson's* 2–2–0 *Engine Planet.*—This engine is shown in Fig. 12 from a drawing by G. H. Phipps,[2] Messrs. Stephenson's chief draughtsman at the time when it was designed.

The main features were the cylinders, 11in. by 16in., which were placed horizontally, and enclosed within the smoke-box, also the first employment of outside "sandwich" frames, with outside bearings, so long a feature of Messrs. Stephenson's designs. These "sandwich" frames were formed of ash or oak planking, strengthened by iron plates on the outside and inside. The axle guards were bolted on to the outside frames. There were four additional inside sandwich frames between the smoke-box and fire-box, the bearings in which supported the crank axle on each side of the crank webs. This axle, therefore, had six bearings. In a subsequent design of about 1832,[3] the inside frames were of iron only, and the inside axle guards were welded on. This was exceptional in locomotive practice of those days, and for many years afterwards it was usual to bolt on the axle guards to both outside and inside frames, though Messrs. Stephenson used welded axle guards for the latter until about 1842. The underhung springs of the Planet should be noted.[4]

In regard to the inside cylinders of the Planet enclosed within the smoke-box, Robert Stephenson said — Proc. Inst. Mech. E., 1852, page 84—that this arrangement was due to a statement made to him by Trevithick. The latter was repairing an old Cornish engine which, unlike others of this type, had no steam jacket, and therefore he built a brick casing round the cylinder with an air space and applied a fire to keep this air heated. With this air jacket the consumption of fuel was only one-fifth of that with the unjacketed cylinder. Stephenson added that he was so much impressed by this result that he designed the Planet with smoke-box jacketed cylinders, and found that considerable increase of power resulted.

The driving wheels of the Planet were 5ft. and the leading wheels 3ft. diameter. The boiler contained 129 1¼in. tubes, and the engine weighed about 8 tons in working order.

*Hackworth's Globe.*—This locomotive, illustrated on page 3 of Colburn's "Locomotive Engineering," was a four wheels coupled engine, built for passenger traffic on the S. and D. Railway. It had a double-cranked axle and inside horizontal cylinders, but the latter were placed at the back end under the driver's platform. The boiler was of novel design, with a single flue fire tube, in the back of which the grate was placed. At the front between the fire bridge and the chimney a number of diagonal water tubes traversed the main flue. Colburn states that these tubes were subsequently removed for the reason that they furred up. A copper drum or steam dome, apparently of spherical shape, was placed on the back of the boiler. A similar spherical dome was shown in the original drawing of Stephenson's "Majestic."

The origin of the crank axle has been strenuously claimed both for Bury and Hackworth. But Robert Stephenson pointed out ("Proc.," Inst. C.E., Vol. 16) that neither Bury, Hackworth, nor his own firm could claim it, since it was embodied in Braithwaite and Ericsson's Novelty. Bury's cylinders, though not quite horizontal, were so nearly so that the earliest combination of horizontal cylinders beneath the smoke-box and crank axle may fairly be claimed for his engine.

Bury's Liverpool and Stephenson's Planet were the first engines to have a true framing, that is, a structure upon which the boiler was carried. Till that time the boiler had formed the attachment to which the engine and bearings were fastened. The cylinders were not secured directly to the frames, but to the smoke-box, and the latter in the Planet was fastened to the outside framing by stays, so that the alternate thrust and pull between cylinders and crank axle had to be transmitted partly in a circuitous path through these stays, and partly, though more directly, through the inside frames.

Bury's engine had no connecting stays at the smoke-box, but the forces were transmitted to the frame through the brackets which connected the boiler to the inside frame. In addition, the top bar of the frame in Bury's early engines was extended backwards to embrace and support the fire-box, to which the draw-bar was directly attached. The Planet was the real point of departure from which the modern British locomotive has been derived, in so far as it combined horizontal cylinders encased within the smoke-box, crank axle, multitubular boiler with fire-box inside it, and a framing, which supported the boiler.

In adopting outside frames Stephenson had in mind a safe support for the crank axle in case of breakage of the latter. Warren records at considerable length the differences between Stephenson and Bury on this subject before the Liverpool and Manchester directors, which ended in instructions being given to Bury to make the Liver, which he was to build for that railway, with outside frames.

The disadvantage of four or six bearings at that period was the difficulty of aligning them truly, and any slight deviation from correct alignment caused extra wear on those bearings on to which the additional load was thrown. One cause of this wear was undoubtedly the fact that materials, machine tools, and exact precision of workmanship were not in those days what they now are. On the other hand, Stephenson's outside and inside bearings had one great advantage in case of the breakage of a crank axle, in that the wheels and axle were held in position and the engine did not leave the rails. A circular issued by Bury, Curtis and Kennedy attempted to prove that the reverse was the case, and that Bury's engines did not leave the rails when the crank axles broke. The arguments were extremely far-fetched, and of the nature of commercial pleading.

To THE ENGINEER of February 2nd, 1923, the writer contributed an account with illustrations of Bury's engines, in which the bar framing as made by his firm was discussed at some length, and therefore it is not necessary to repeat particulars so recently given. A considerable number of Bury's engines were exported to America, and the bar frames appealed to engineers in that country, where they have become universal.

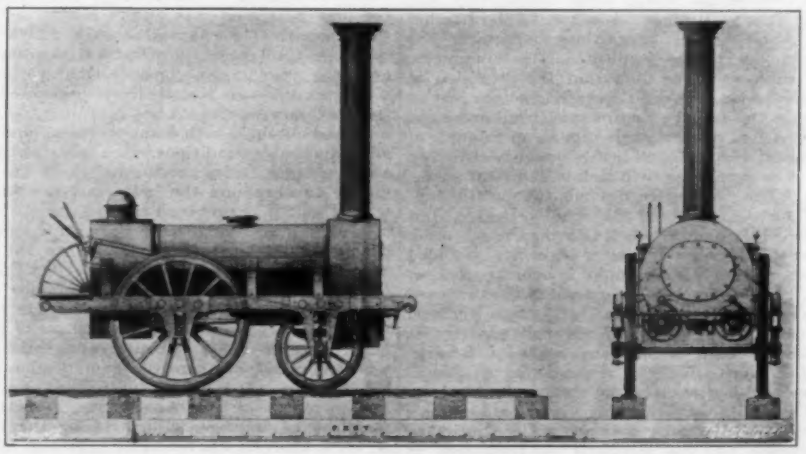


FIG. 12—STEPHENSON'S "PLANET," LIVERPOOL AND MANCHESTER RAILWAY, 1830

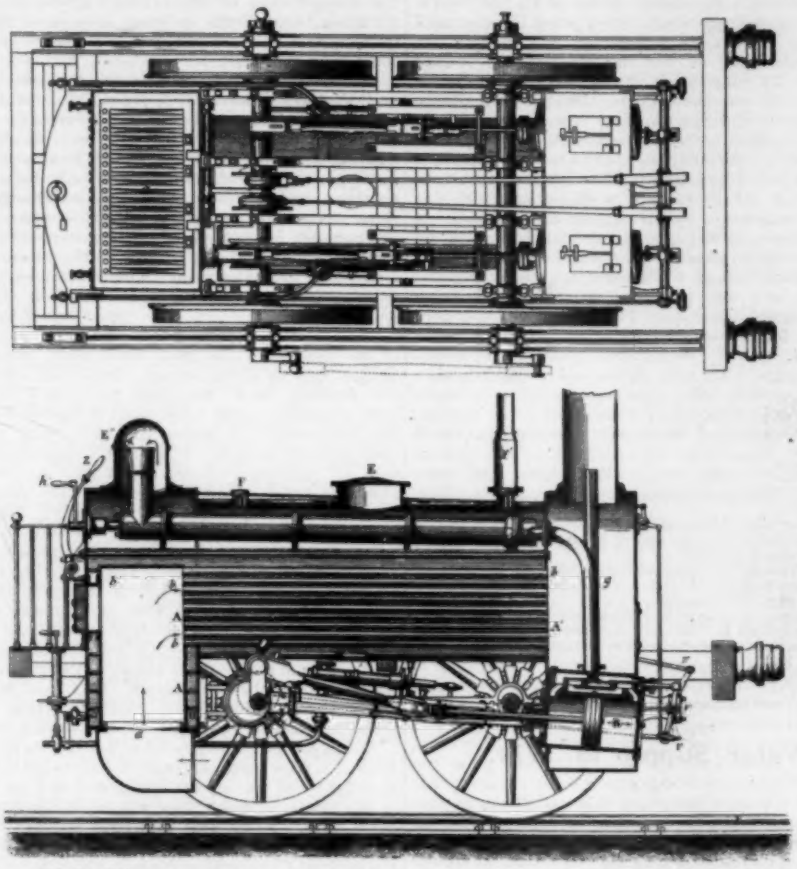
*Stephenson's* 0–4–0 *Goods Engines*, 1831.—In 1831 R. Stephenson and Co. modified the "Planet" type of engine by making the four wheels of equal diameter and coupling them together. Engines of this type, Samson and Goliath, were built for heavy goods and banking work on the Liverpool and Manchester Railway. They had 14in. by 16in. cylinders and 4ft. 6in. wheels, and weighed 10 tons. A similar engine by Stephenson and Co. for the Glasgow and Garnkirk Railway had 11in. by 16in. cylinders.

It may be mentioned here that R. Stephenson and Co. supplied their drawings to various other firms, whom they recommended for orders. Robert Stephenson was himself a partner for a short time in the firm of Tayleur and Co., and amongst other firms which

* No. II. appeared January 9th.

for some time built engines by arrangement with Stephenson's was Fenton, Murray, and Jackson, of Leeds.

The illustrations Fig. 13 have been selected to show the framing which is typical of the later "Planet" and "Samson" type engines. In addition to the outside sandwich frames, which contained the main bearings and carried the weight, the four inside bar "frames," or in reality stays with bearings for the driving axle, extended between the cylinders and the fire-box. Although these stay frames embraced the leading axle, the latter had no bearings in them. In some cases the inside frames had springs to take a small portion of the weight, and the inside bearings had a double wedge adjustment.[5]

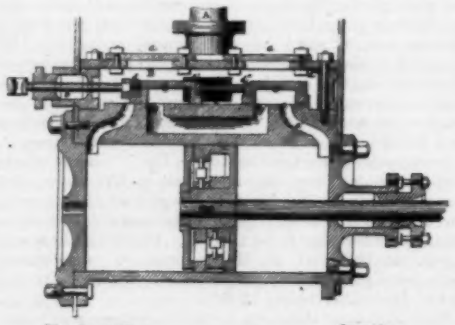


"THE ENGINEER" SWAIN Sc.

FIG. 13 SECTIONAL ELEVATION AND PLAN OF 0-4-0 GOODS ENGINE, 1831

The modification shown in Fig. 13 appears to have had as its object the relieving of the crank axle from bending strains due to the expansion of the boiler. The outside driving cranks for the coupling rods had spherical pins, but the leading cranks had parallel pins.

The cylinders and valves (Fig. 14) merit attention, in that divided slide valves were used, and appear to show that the detrimental effect of long ports in adding to the clearance spaces was then understood. But since the piston stroke was short in proportion to the cylinder diameter, such valves were a needless refinement. The valve spindles were placed at the front and were actuated by a long transverse rocking shaft behind the front buffer beam, as shown in Fig. 13. The cylinders of all these early engines were fitted with end flanges bolted to the front and back plates of the smoke-box. The two cylinders were not directly connected together.



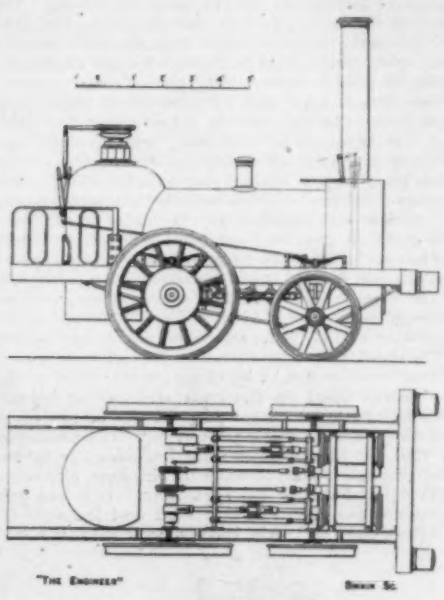
"THE ENGINEER" SWAIN Sc.

FIG. 14—CYLINDERS AND VALVES

Two 0-4-0 engines by Stephenson (1832) for the Liverpool and Manchester Railway, the Atlas, and probably the Milo, were fitted with piston valves having split rings. These were the earliest examples of piston valves.

*Rothwell and Hick's 2-2-0 Engine*, 1832.—Although inside frames were usually of bars at this early period there were instances of engines with inside sandwich frames only. The four-wheeled engine Pioneer (Fig. 15), built in 1832 by Rothwell, Hick and Rothwell, of Bolton, for an American railway, presents an example. It has several features in common with Bury's engines, including the D fire-box, but the important difference lies in the frames. The dimensions of the Pioneer were:—Cylinders, 9in. by 14in.; leading wheels, 3ft.; driving wheels, 4ft. 6in.; boiler, fifty tubes, 1¾in. diameter. An interesting detail is the variable blast pipe, which had an inverted cone in the orifice. The amount of opening could be controlled by the driver. The valve gear was of the single loose excentric type, but the mechanism for disengaging from the slide valves, when it was necessary to reverse the engine, is not shown. The original drawing from which the illustrations are made was probably sent to America with the engine; it came into the hands of the president of the Richmond, Fredericksburg and Potomac Railroad, who lent it for publication in the *Railroad Gazette*, April, 1901.

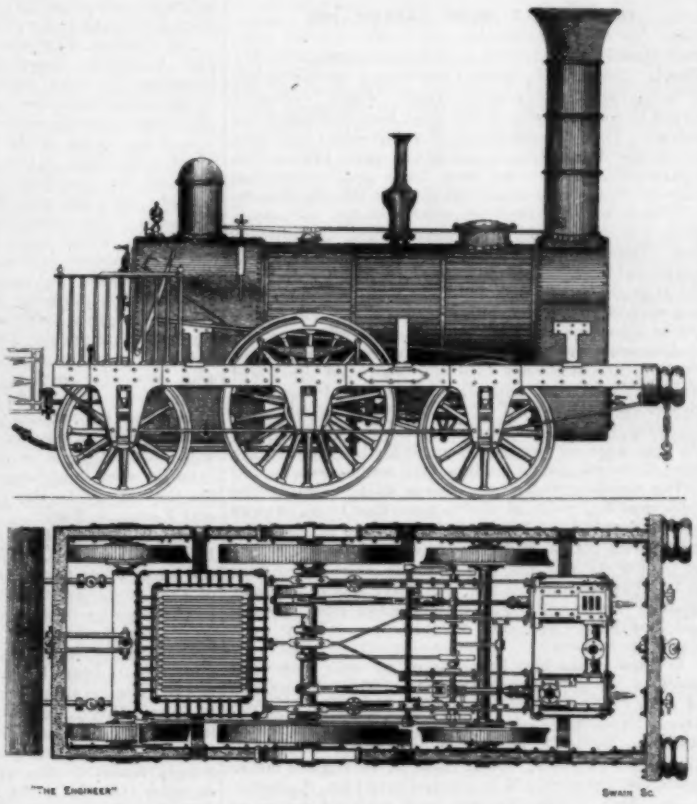
*Stephenson's Six-wheeled Engines.* — The Liverpool and Manchester Railway had been laid with very light fish-bellied rails, 35 lb. to the yard, and it was soon found that the later "Planet" class, weighing 9 tons total with 5½ tons on the driving wheels, was too heavy for the road. Moreover, having four wheels only with the driving wheels in front of an overhanging fire-box, they were somewhat unsteady, in spite of the inside cylinders, though much of this unsteadiness might fairly be attributed to the permanent way. Pending the relaying of the latter with heavier rails, it was decided by Stephenson to add a third pair of wheels behind the fire-box. Edward Woods stated that the additional wheels were not intended to relieve the driving wheels of any great part of their load, but to check the pitching of the engine by taking a part of the weight at the time of plunging. The trailing springs therefore carried a very light load. This was the origin of what was formerly termed "Stephenson's patent engine," which ran on six wheels, one pair being behind the fire-box. The 2-2-2 engine, thus produced, became a standard express and passenger engine and was built in this country from the end of 1833 until 1894. The first new engine of the type, named Patentee, was built for the Liverpool and Manchester Railway. An engine somewhat similar to the Harvey Combe of 1835 but built in 1837, with several improvements, is illustrated in Fig. 16. A very full description of it is given in Tredgold's



"THE ENGINEER" SWAIN Sc.

FIG. 15—2-2-0 ENGINE "PIONEER," 1832

"Steam Engine." This description is worth careful study, since it shows in how very few essential details Stephenson's locomotive of 1835 differed from that of to-day; in fact, the principal differences lay in the use of the old fork instead of the link motion, in the absence of sufficient lap on the valves for expansive working, and in the draw-bar attachment to the fire-box. Seeing that only six years had elapsed since the construction of the Rocket the progress made in design was truly wonderful. A few of the more important details may be mentioned here. The outside sandwich frames (see plan, Fig. 16) were attached by brackets to the smoke-box, to the middle of the boiler, and to the fire-box. The engine, however, "pulled through the fire-box," the draw links being attached to a channel bracket riveted to the back of the casing. There were two inside plate frames with driving axle guards welded on, and a fifth bearing was provided



"THE ENGINEER" SWAIN Sc.

FIG. 16—STEPHENSON'S 2-2-2 ENGINE OF 1837

in a Y centre stay. The cylinders, 12in. by 18in., were encased within the smoke-box and were not attached directly to the frames, a feature already mentioned in connection with the Planet. The steam chests were separate from, but bolted, to, the tops of the cylinders, and all steam joints were made with gasket or canvas covered with red lead and oil. The valve spindles were connected to the valves by means of a rectangular wrought iron frame or buckle dropped over the valve as in present-day practice. The slide valves had $^1/_{16}$in. outside and $^1/_{16}$in. inside lap to ensure that the steam port was completely closed before the opposite steam or the exhaust port was opened. Lead was given to the valve, but there was as yet no real attempt at expansive working. The effect of clearance was fully understood, and in some of the earlier engines short straight ports with a slide valve in two parts had been tried and abandoned owing to complication.[6] The piston rings consisted of one broad outer and a similar inner ring, which were turned exactly to fit the cylinder and each other and cut through in one part, having been first hammered a little all round on the inside to make them press evenly against the cylinder walls. Bent springs of flat steel were placed inside behind the rings to regulate the pressure as the latter wore down. The gudgeon pins had spherical journals on which the brasses of the connecting-rod small ends worked, and allowed for any slight deviation from squareness of the connecting-rods. The spherical gudgeon pin bearings reappeared in 1907 on some Midland engines, more than seventy years after their use by Stephenson.

The crank pins were turned in the same manner as is done to-day, that is, by chucking the axles in cast iron blocks fixed on the ends and having balance weights, the lathe centre pops in the blocks corresponding with the crank pin centres. The crank pins for 12in. by 18in. engines were 5in. diameter by 3in. long, journals 3¼in. diameter by 5in. long, and wheel seats 5¼in. diameter by 7¼in. long. The fore gear excentrics were fixed in the usual position near the middle of the crank axle, but the back gear excentrics

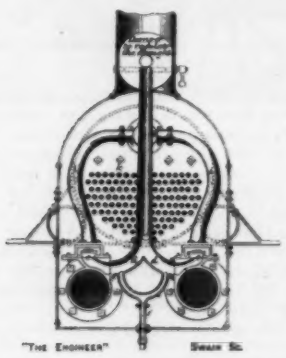



FIG. 17—2-2-2 ENGINE EXHAUST PIPE

were placed between the inside frames and the driving wheels, immediately behind the bosses of the latter. A long transverse rocking shaft, which extended across the engine above the slide bars, actuated the valves. This arrangement of valve gear was used on many of Stephenson's engines until 1841. The separation of the fore and back gear excentrics allowed room for a centre bearing on the crank axle.

It was a long time before the design of wheels settled down to anything approaching uniformity, and Stephenson's wheels at this period differed considerably from wheels as we now know them. In the engines under consideration the hollow boss and rim were of cast iron. The rim was also made with a hollow groove round it to lessen the weight. The spokes were wrought iron tubes tapering from 2¼in. to 2in. diameter cast into the boss and rim, and arranged so that alternate spokes slanted in opposite directions. The tires of the driving wheels, 5ft. diameter, had a mean thickness of only about $1^7/_{16}$in.; all tires were of wrought iron, welded. The driving tires of Stephenson's engines had no flanges.

The fire-box had water spaces 3½in. wide at the sides and 4in. wide at the front. The $^7/_{16}$in. copper plates were set in all round the fire-hole to meet the iron casing plates, and the two were riveted together by copper rivets. The pressure was 50 lb. per square inch. The arrangement of side stays was practically what it now is; the ¾in. copper stays were screwed full length and the ends riveted over. They were spaced 4in. apart.

Copper tubes had been found to wear out very quickly owing partly to the effect of hard particles of coke. Hard brass tubes were suggested by Mr. John Dixon, then of the Liverpool and Manchester Railway, in 1833, and were afterwards used with much better results. These tubes in the engines under consideration were 124 in number and 1¾in. diameter, $^1/_{13}$in. thick. After having been soldered inside at the joint they were drawn through a circular steel die to make them truly cylindrical. They were ferruled at both ends with steel ferrules, iron ones having been found to wear more quickly.

The blast pipe was of copper, 3¾in. diameter at the bottom and tapered gradually to 2¼in. diameter at the orifice. The breeches pipe, which connected the cylinder exhaust flanges with the blast pipe, was provided with a small outlet pipe underneath each of its branches (Fig. 17). These pipes united into a single vertical pipe with outlet at the bottom underneath the cylinders and closed by a cock. Their original object was to drain the water from the breeches pipe. Mr. Edward Fletcher fitted similar cocks underneath the steam chests of all the North-Eastern engines, on which they were in use until 1883; but their main object on this railway—at least in the eyes of the drivers—was to reduce the force of the blast by diverting part of the exhaust steam directly into the open air through the exhaust cock instead of through the blast pipe.

In such engines as had no ashpans, and they were the majority, a butterfly damper valve was placed in the bottom of the chimney. The objection to ashpans was due to the custom of dropping the fire at the end of a journey by pulling out the fire-bars. A steam dome on the fire-box was provided, since in the very early engines great difficulty had been experienced in preventing priming. The regulator was of the disc valve type and was placed in the horizontal steam pipe underneath the dome. The disc valve faces were ground to form a steam-tight joint when the valve was closed.

Feed pumps with ball clacks and worked from a direct connection with the piston-rods were used. The ball clacks were the invention of John Melling, of the Liverpool and Manchester Railway, on which they were introduced about 1834. The pumps were provided with pet cocks, which had been invented by George Stephenson.

[1] The expression "Schools of Locomotive Engineers" is due to J. E. McConnell, who used it in his evidence before the Gauge Commission in 1845.
[2] Wood's Treatise on Railroads, 1831 edition. Reproduced by Warren, page 254.
[3] Warren, page 280, drawing.
[4] Later engines of the type had springs above the frames.
[5] See illustrations in Warren, page 280. Ordinarily, these inside frames were axle supports, but carried no weight.
[6] See Fig. 14.

## Water Supply in 1924.

No. I.

IT is satisfactory to be able to report, after so many years of comparative stagnation, that there are at length signs that matters are improving in water-works engineering. It cannot, of course, be said that operations have yet reached pre-war level; nevertheless, as will be seen in what follows, there is a considerable amount of work in hand, while many important schemes are in contemplation.

### Metropolitan Water Board.

We are indebted to Mr. Henry E. Stilgoe, Chief Engineer of the Metropolitan Water Board, for the following information regarding work completed during the year and now in progress.

*The Littleton Reservoir and the Supply Therefrom.*—The Littleton Reservoir and contingent works, including the inlet pumping installation, progressed so far during the year that they will be completed in the coming spring, with the exception of the top portion of the lining of the inner slopes of the reservoir, which will consist of pre-cast concrete blocks laid dry, and will be completed after the reservoir has been brought into use and the banks have become consolidated. The construction of the conduit for conveying the water from the reservoir to the existing Staines aqueduct and to the filter beds at Kempton Park and Hampton was proceeded with. It consists of about 100 yards of twin 8ft. diameter reinforced concrete conduit, 3900 yards of 6ft. diameter reinforced concrete conduit, and about 2900 lineal yards of 48in. diameter cast iron pipe. The 8ft. diameter and 48in. diameter sections were practically completed, while about two-thirds of the 6ft. diameter section remain to be constructed. The connection to the existing Staines aqueduct was practically completed with the exception of the actual breaking in to the existing work, and branch connections have been left for the supply to the filter beds at Hanworth-road and Kempton Park.

The laying of a 48in. diameter cast iron main from Kempton Park to Cricklewood was continued. From the latter place two lines of mains having a diameter of 42in., reducing to 36in., are being laid to connect to the Board's western and northern district systems at Marble Arch and Clerkenwell respectively, with branch connections along the routes. The 48in. diameter main from Kempton Park will be connected to the existing 42in. diameter main from Cricklewood to Fortis Green Reservoir, which will act as a jack head to the system. Connections will also be made between the existing pumps at Cricklewood and the supply mains to the western and northern districts in order that the additional supply to those districts may be afforded either direct from Kempton Park or through the existing second-stage lift pumps at Cricklewood. The pumping machinery required for the supply of filtered water to the above system of mains, which is in course of construction, will consist of two pumping units, each having a maximum of about 1010 P.H.P. This installation will be housed in a new building at Kempton Park. In order to supply the additional quantity of filtered water to be obtained from Littleton an installation of twenty-four primary rapid filters is to be constructed at Kempton Park, the raw water being obtained through connections from the conduit described above. It is not intended at the present time to construct any further slow sand filters, as it is anticipated that by the interposition of the primary filters the rate of filtration through the existing slow sand filters can be increased to meet the requirements of supply for some time to come.

*Intercommunication Works Between the Southern and Northern Districts.*—A main, 24in. in diameter, through the Thames Tunnel to Tower Hill, will be completed at an early date. It will duplicate an existing main through this tunnel 20in. in diameter, forming an intercommunication link between the southern and northern areas of the Board. Both these mains are connected on the southern side to the recently completed ring main, 36in. in diameter, which is fed directly by pumps at Hampton and also from Nunhead Reservoir, which receives its main supply through a 42in. main, also fed from the pumps at Hampton.

*Works for the Improvement of River Supply South of the Thames.*—The 36in. main from Westminster Bridge-road to Tooley-street, Southwark, connecting the existing 36in. pumping main from Hampton with the 36in. outlet main from Nunhead Reservoir, was completed. It forms the connecting link in a high-pressure system. The construction and installation of eighteen primary rapid and six secondary slow sand filters at Walton was proceeded with and will be completed during 1925. The extension of the existing pumping station at Walton was practically completed and the erection of the machinery is in progress. The new filtered water supply from this station will be delivered through a recently completed main, 48in. in diameter reducing to 36in. diameter, between Walton and the Board's existing reservoirs at Brixton and Honor Oak. Connections from this main to the Board's existing supply mains at Clapham Common, Peckham Rye, and Queen's-road, Camberwell, and to their existing reservoir at New Cross will be laid during 1925.

*Works for the Improvement of the Supply in the Kent District.*—The pumping station buildings at the new Eynsford well was almost completed and the erection of the pumping machinery will be commenced at an early date. From this pumping station are being laid 12in. mains to Swanley, and to a new service reservoir at Chelsfield to contain about three-quarters of a million gallons, the construction of which is almost completed. Designs are being prepared for the reconstruction and centralisation in one engine-house of the pumping machinery at Deptford, which is the chief centre from which is afforded the supply to the metropolitan area of the Kent district.

*General.*—For the purpose of improvement of supply the laying of the following trunk mains is in progress:—A 24in. diameter main from Wood Green to Southgate in the Northern District; an 18in. diameter main from Ealing Common to Northfield-avenue in the Western District; a 15in. diameter main reducing to a 12in. diameter main from the Board's Nunhead Reservoir to Catford and Lower Sydenham.

### Liverpool.

*Vyrnwy Supply: Aber Tunnel.*—By the middle of October of 1923 the inlet heading had been driven for a total length of 430ft., and it became necessary to provide artificial ventilation. To provide for it, and also for the operation of the mechanical drills and the lighting of the heading, a small electrical generating station was erected at the tunnel mouth. The generating plant consists of a 14 brake horse-power crude oil engine coupled direct to a 230-volt continuous-current 8-kilowatt dynamo. The ventilating plant is situated at the entrance to the inlet heading and consists of a 10in. fan driven by belt from a 6 horse-power electric motor. The volume of air now being delivered from the fan is 650 cubic feet per minute. As the heading progresses the present 6in. air pipe will be moved forward and replaced by a 10in. diameter pipe from the fan. Power drilling was begun at the end of March and it accelerated the rate of progress, the total length driven up to the end of December being 1200ft.

*New Filters at Oswestry.*—Good progress was made with the construction of the three additional filters and central sand-washing depôt, the contract for which was let in 1923. Work was begun on the site of the new beds at the beginning of April, 1923, and, at the same time, the contractors opened up the old Bwlch Quarry, and also the Glopa Sand Pit, to obtain material for concrete. The filter walls were first proceeded with and, with the exception of a few gaps, left for expansion or to obtain entry to the beds, were completed by the end of December. Concreting operations were considerably interfered with during the winter by frost. Although the frost was not very severe, it continued from the middle of February until the end of March. Two sand washers were installed to wash the sand and get rid of particles too fine for filtering work. The contract for the construction of the filter beds was completed at the end of October last.

*New Trunk Main, Prescot, Liverpool.*—The laying of the new trunk main between Prescot and

Liverpool, which is 6½ miles in length, was completed and the main brought into commission in May. The pipes are 42in. internal diameter for about half the length, after which they diminish to 40in. diameter. They are of cast iron lined with concrete applied centrifugally. The most difficult part of the pipe laying was met with in passing through Knowsley Park, where for a length of 1500 yards the bottom of the pipe trench was over 17ft. below the surface of the ground. This deep cutting was in hard rock, consisting of gannister and other hard material in the coal measures. Pipes of increased thickness were used at this point, and, as was done at all places where rock was met, they were embedded in concrete carried up to the half diameter. The new main is capable of conveying 18 million gallons per day into the city, and this additional water has improved the supplies over a large portion of the area. Before being brought into use the main was thoroughly tested under the maximum head, and it is satisfactory to note that no defect, either in the pipes or jointing, was revealed.

**Manchester Water Supply.**

The Water Department of the Manchester Corporation has in progress new works of the aggregate value of between 1½ and 2 millions sterling, upon which about 2000 men are employed.

*Thirlmere.*—Works for the diversion into Thirlmere of the drainage of about 2400 acres forming the north-easterly part of the watershed, which were started in October, 1923, made good progress during the year. These works are being carried out by administration, and consist of a short length of tunnel, and about two miles of open watercourses, with catchwaters, &c. About two-fifths of the total length of the watercourse was completed by the end of November.

*Thirlmere Aqueduct.*—The laying of a fourth pipe line from Thirlmere, which was commenced in June, 1922, was nearly completed. The pipes are 54in. internal diameter, and about 26 miles of them are of welded steel, 4¼ miles of "Bonna" reinforced concrete, about one mile of concrete lined cast iron, and the remainder of unlined cast iron. It is not proposed to lay the pipe line at present beyond Lostock, which is about 15 miles from Manchester. At that point the first instalment of an electrically-driven boosting plant is in course of erection. The plant is so designed as to permit of the boosted head being varied to suit the growth in demand, and will obviate the necessity of laying, for a number of years yet, the last syphon of the fourth pipe line, which is about 14 miles in length. About 1¼ miles north of the site of the booster station reinforced concrete straining chambers are being constructed. The whole of the water drawn from Thirlmere will be passed through these chambers on its way to the city. Although all flotant matter contained in the water is arrested by strainers at the aqueduct intake from Thirlmere, it is found that towards the end of summer, especially after a spell of hot weather, the water, as it enters the last syphon at the Manchester end, is to a slight extent charged with minute particles of fine moss, &c., gathered by the water in passing through the tunnels and covered channels. The new straining chambers are close to the north well of the last syphon, and are intended to prevent these fine solids passing forward into the terminal reservoirs and distributing system. The work is approaching completion and will be ready for use before next summer.

*Heaton Park Reservoir.*—The construction of a service reservoir of 550 million gallons capacity at Heaton Park, about 4¼ miles north-east of the city, which was stopped owing to the war, in 1915, was resumed in 1922. The work, which is being carried out by administration, affords employment for about 450 workmen, and made satisfactory progress, although puddling operations were considerably hampered by lengthy spells of frost in the early months of the year. During the year an area of about 15 acres of the reservoir basin was excavated to formation level, and about 60,000 cubic yards of the excavated materials taken for banking or spoil. About 70,000 cubic yards of clay puddle lining have been put in, about 9 acres of beaching have now been laid in the reservoir bottom, and about one acre of square pitching completed on the banks and slopes. Extensive beds of peat and running sand, and large quantities of spring water, were encountered but were successfully dealt with. The puddle work done prior to the closing of the works in 1915 was found to have developed cracks of considerable depth in places, and for a length of about 650 yards the puddle core of the embankments was similarly affected. These faults, which have been made good, entailed a considerable amount of unanticipated labour. Suitable clay and gravel, sufficient to complete the reservoir, were discovered on land in close proximity to the site, and as that meant a very substantial saving in cost, compared with that of obtaining the clay from other known sources in the district, it was decided to purchase the land, which will be restored for agricultural purposes on completion of the works.

**Cardiff.**

*Llwynon Reservoir.*—In spite of the wet summer and of heavy flooding of the river Taff on several occasions, the main embankment and the overflow weir and by-wash, together with subsidiary works, roads and the clearing of the site by the demolition of buildings, &c., were completed during the year.

*Roughing Filters.*—Good progress was made with the construction of the Cantref roughing filters, the work being now rather more than half completed. The twelve reinforced concrete filter units, the pipe gallery and the filter floors were completed and the fixing of the pipe work and valves is nearly done. The construction of the clear water reservoir was finished, and the walls of the filter house erected to the level of the top of the filters.

*Taff Fawr Conduit : Second Pipe Line.*—The laying of the upper section of 14 miles of 28in. diameter concrete-lined steel pipes between Cantref reservoir and the proposed Goitre Coed reservoir, Abercynon, proceeded during the year, and about three-quarters of the total length is now laid. It is hoped to have this section completed by next June. Tenders were obtained for the concrete-lined steel pipes required for the lower section from the Goitre Coed reservoir to the Llanishen reservoir, near Cardiff, and that of Guest, Keen and Nettlefolds, Limited, of Cardiff, was accepted.

*Wenallt Reservoir.*—The foundations for the Wenallt reservoir were practically completed by March, 1924. The work was then closed down, but the construction was recommenced in November. This reservoir, which is elliptical in plan, will contain 15 million gallons, and is to be constructed of mass concrete faced with blue brick. It is for the supply of the high-level district of Cardiff.

**Belfast Supply.—The Silent Valley Reservoir.**

The work in connection with Belfast Silent Valley reservoir scheme was largely of a preliminary character, and consisted of the construction and completion of about 6 miles of works railway, extending from the port and town of Annalong, across country up to the site of the reservoir in the "Silent Valley," and also of the construction of about 5 miles of additional branch and extension railways at different elevations in the Mountain Valley, to provide access and control at the higher levels of the work in the concrete trench and main embankment, as well as to make connection to the granite quarries which are being worked above top bank level. Considerable progress was also made with the sinking in granite rock of the main valve shaft, and with the driving or tunnelling through rock, of the north and south "crown headings," from this valve shaft, to form the main outlet tunnel. The south "crown heading" has already been driven from the valve shaft into the open cutting at Main Tailbay, and it is expected that the north "crown heading" will also be driven through the granite rock into the open cutting at the forebay, early in the New Year.

The open outlet channel, from the south end of the tailbay, into the main river, was partially excavated, and a portion of the concrete floor formed to the permanent levels, while some progress was made with the excavation and grading of the southern portion of the new high-level roadway, on the east mountain slope, along which a temporary extension railway will be constructed for conveying the necessary plant and materials required for forming the eastern portions of the concrete trench and the main embankment. The seat or base of the main embankment is now being cleared of the soil and soft materials, in preparation for the grading and laying of the arterial and subsidiary drains within the base of the main bank, and portions of the inner and outer "rubble toes" have already been formed in position, as a preliminary work, before any of the clay layers are deposited in the main embankment. The detached and semi-detached villas for accommodating the principal members of the contractors' staff, as well as the foremen's semi-detached houses, and nine of the hutments for housing the gangers and workmen, were completed and occupied in the early months of the year, and a further number of hutments for additional workmen is now in course of erection. An efficient water supply was laid on to all the housings and other buildings, for domestic and fire-extinguishing purposes, and septic tank and sewage filtration systems were installed and are at work to prevent pollution of adjoining rivers and streams.

A recreation hall containing a concert and cinema hall, separate billiard, reading and refreshment rooms, and attendants' apartments, a detached hospital building are being built, while the numerous other buildings, such as the contractors' main offices, an electric power station, cement and general stores, a mechanics' shop, saw mills, locomotive sheds and other similar works buildings were completed and put into service. Special plant and machinery, of different kinds, are in course of erection for stone crushing and stone dressing, and also for excavation and concrete purposes when machines are erected and in use.

**Glendevon Waterworks.**

The Glendevon reservoir site, which is on the head water of the river Devon, commands a drainage area of close on 6000 acres of clean hill pasture land, yielding water which is characterised by its purity and softness. The average gross yield of the drainage area is 11,575,500 gallons per day. Upon that basis, compensation water which has to be delivered into the stream at a uniform rate throughout the year has been fixed at 3,858,500 gallons per day. The promoters are entitled to draw 4,500,000 gallons per day from the reservoir, but may not draw more until they construct another reservoir on the upper reaches of the Devon.

The reservoir embankment at Glendevon is the highest of its kind in Scotland, and one of the highest in the United Kingdom. It stands 108ft. from the bed of the stream. The inside slopes vary in batter from 1 in 4 at the lower depths to 1 in 3 above, while the outside slope is 1 in 2¼ overall, with two berms each 15ft. in width. The reservoir, when full, has a water surface of 100 acres, and a storage capacity of 1000 million gallons. Construction work on the reservoir was commenced in the spring of 1915 under a contract, but, owing to the scarcity of labour and the difficulties arising from war conditions, the contract was abandoned, and after a short interregnum and for two years following the spring of 1917 the work was carried on by German prisoners. It was finally completed towards the end of last year by Wilson, Kinmond and Marr, Limited, under a contract.

The puddle trench, which was carried down to a maximum depth of about 80ft., is bottomed throughout its length in solid whinstone. During the construction of the reservoir embankment, the river was carried in a concrete culvert lined with bricks. This culvert is connected with a red sandstone water tower, surmounted by a valve chamber built in the Scottish Baronial style of architecture. The gangway to the tower consists of two lattice girders of 60ft. span, supported on intermediate piers of masonry, and, at the shore end, of three masonry arches of 9ft. 9in. span, carrying the approach to the gangway. The tower is of the dry tower type, and affords access to the valves and spindles by which the discharge from the reservoir is regulated. The waste weir is 200ft. wide, and is swept gradually into a steep waste water channel, 26ft. in width, as the fall of the channel increases. The floor of the channel has been formed in the rock in a series of natural cascades.

The supply of the water is primarily for the Dunfermline district of the county of Fife, which has a population of 35,000, and also for H.M. dockyard at Rosyth. Supplementary supplies of water are to be given to the burghs of Dunfermline, Inverkeithing, Culross and Lochgelly, and also to part of the Kirkcaldy district of the county of Fife. The county of Clackmannan and the burgh of Alloa have also options to obtain a supply from the new reservoir. The estimated cost of constructing the reservoir and laying the supply pipe to Glenquey gate was £196,000. The actual expenditure has amounted to approximately £400,000.

## A NEW METHOD OF HIGH FREQUENCY RESISTANCE MEASUREMENT.

IN wireless work the measurement of high-frequency resistance is, of course, a matter of considerable importance, and a good many methods have been devised. It is pretty generally agreed, however, that there is room for other methods which are reasonably simple and which will give accurate results. A new and ingenious method was described in a paper read on Wednesday, January 7th, before the Wireless Section of the Institution of Electrical Engineers, by Professor E. Mallett and Mr. A. D. Blumlein, of the City and Guilds College. The resistance of an oscillatory circuit is measured at resonance without any electrical connections being made to it. The circuit, the resistance of which is to be determined, is coupled magnetically with a coil, and the magnitude of the ratio of the effective impedance of the coil to that of the coil alone is measured at various points as resonance of the circuit is passed through by alteration of the frequency of the supply. A resonance curve of the impedance ratio is plotted against the supply frequency, and from this curve the high-frequency resistance of the circuit is determined by the use of a graphical construction involving a circle diagram. The construction gives also the value of the resonant frequency of the circuit. Alternatively, if the tuning of the oscillatory circuit can be varied by means of a variable condenser the impedance ratio curve can be obtained without variation of the supply frequency.

The graphical construction described in the paper appears a little laborious and complicated, but Professor Mallett assured those present at the meeting that such was not really the case. One of the main advantages of the method is that the circuit to be tested has no electrical connection made to it and its tuning need not be altered. The method is therefore suitable for measuring the resistance of coils at their natural frequency and in cases in which a change of tuning is impossible. The resistance is determined by a number of points lying on a straight line and an estimate of the accuracy of a measurement can be obtained by observing whether or not the points do lie on a straight line. The value of the mutual coupling does appreciably affect results. The measurement of the departure of the frequency of a supply from the natural frequency of a given standard can be made with very great accuracy, and this method of frequency determination may prove of value.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The next examination for associate membership of the Institution of Electrical Engineers will be held on April 2nd, 3rd and 4th. Candidates must be either students or graduates of the Institution or have lodged with the secretary a duly completed form "E" for election as associate member. Entry forms for the examination, which must be completed and returned by February 1st, and particulars regarding election to membership of the Institution may be had on application to the secretary, the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2.

# The Friction of Pistons and Piston Rings.

By T. E. STANTON.

RECENT investigations carried out at the National Physical Laboratory for the Lubrication Research Committee of the Department of Scientific and Industrial Research have indicated that in the lubrication of surfaces in which the relative motion is of a reciprocating nature, as distinguished from the unidirectional motion of a shaft journal, the surfaces, as would be expected from theoretical considerations, are not in general separated by a film of the lubricant of sufficient thickness for the ordinary theory of lubrication to be applied to it, but the condition is that which has been denoted by Mr. W. B. Hardy, "boundary lubrication," *i.e.*, the distance between the surfaces is of molecular dimensions. In this condition, the resistance to the motion follows the well-

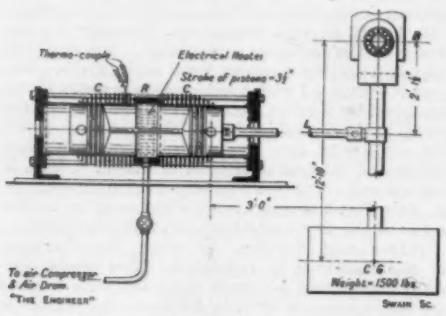



FIG. 1

known laws of solid friction, the resistance being proportional to the load and independent of the speed.

In the experiments on the cylindrical bearings of heavy pendulums described in THE ENGINEER for June 29th, 1923, these laws were found to be accurately followed, and it was found possible to obtain considerable reductions in the coefficients of friction of mineral oils by the addition of small quantities of fatty acids to them.

In view of the interest which has been recently aroused in the nature of the friction between the pistons and cylinders in internal combustion engines, and its variation with load, this investigation has been extended to the case of pistons and piston rings, and the results obtained, by permission of the Aeronautical Research Committee, form the subject of the present note.

## METHOD.

The apparatus consists of a heavy pendulum in ball bearings and swinging under gravity through a small arc—Fig. 1. Two spare engine cylinders are coupled together coaxially by bolts passing through end covers, and having a common head R recessed to take the cylinder ends and forming with them a gas-tight space between the two pistons, which are also rigidly coupled together. The combined cylinders are mounted on a bed-plate carried by the stanchions of the building, and with their axis horizontal and in the plane of swing of the pendulum. The coupled pistons are connected by a rocking link to the shank of the pendulum as shown.

In order to study the friction under the conditions of practice, the interior of the head R was fitted with an electrical heater, and the walls of the cylinder with a thermo-couple, so that the walls could be maintained at the desired temperature. For the purpose of determining the effect of the gas pressure, a connection was made between the head R and an air drum, in which pressures up to 80 lb. per square inch could be maintained. Further, to measure the intensity of pressure at the back of the rings, which pressed them against the walls, small holes were drilled through the metal of the pistons at the bottom of the ring recesses and connected by means of a strong rubber pipe to a Bourdon pressure gauge.

Neglecting the air resistance of the pendulum and the friction of the ball bearings, the system of pendulum and pistons will oscillate with a damping factor, which, when determined, enables the mean friction between the pistons and the cylinder walls to be calculated.

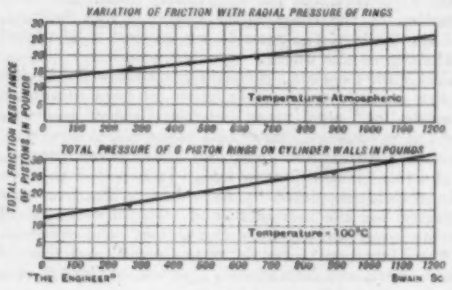
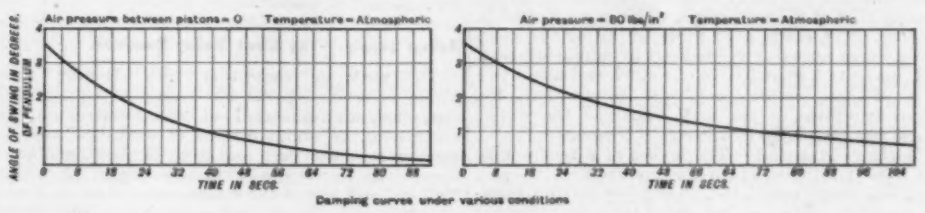

VARIATION OF FRICTION WITH RADIAL PRESSURE OF RINGS
TOTAL FRICTION RESISTANCE OF PISTONS IN POUNDS
Temperature = Atmospheric
TOTAL PRESSURE OF 6 PISTON RINGS ON CYLINDER WALLS IN POUNDS
Temperature = 100°C
"THE ENGINEER"
SWAIN Sc

FIG. 3


Air pressure between pistons = 0
Temperature = Atmospheric
Air pressure = 80 lbs/in²
Temperature = Atmospheric
ANGLE OF SWING IN DEGREES OF PENDULUM
TIME IN SECS.
Damping curves under various conditions

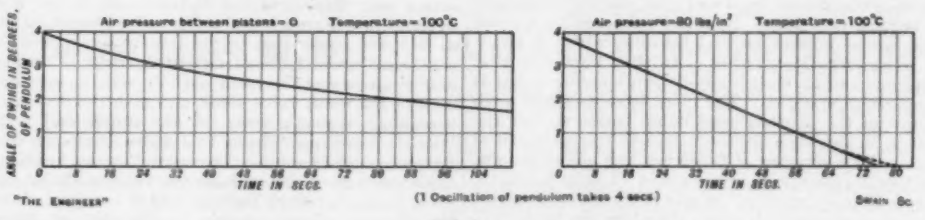

Air pressure between pistons = 0
Temperature = 100°C
Air pressure = 80 lbs/in²
Temperature = 100°C
ANGLE OF SWING IN DEGREES OF PENDULUM
TIME IN SECS.
"THE ENGINEER"
(1 Oscillation of pendulum takes 4 secs)
SWAIN Sc.

FIG. 4

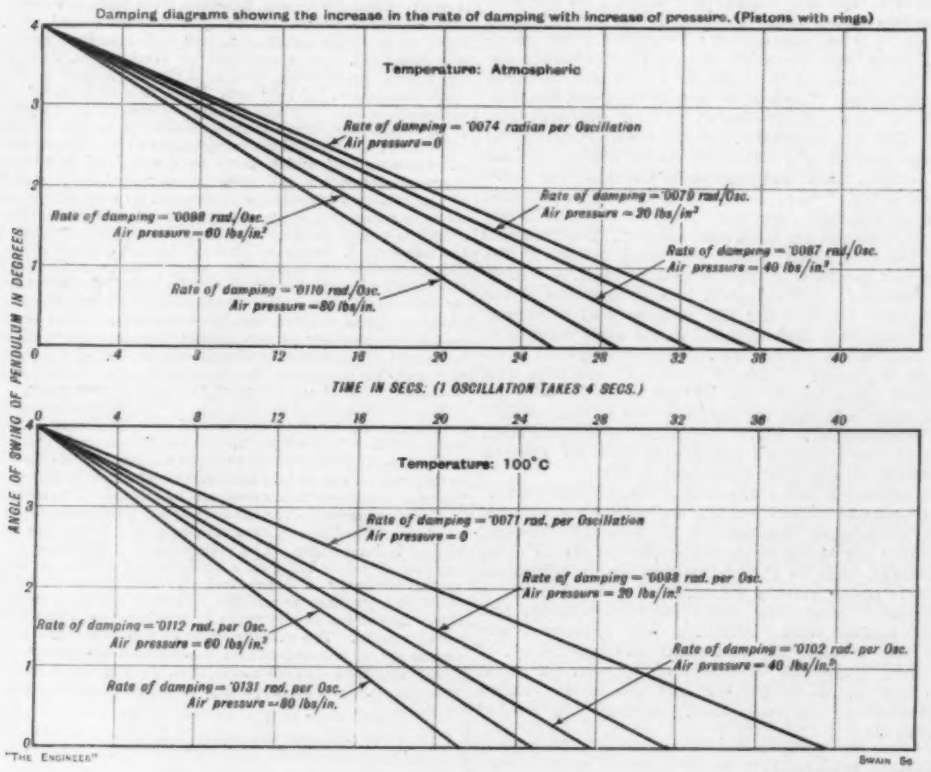

Damping diagrams showing the increase in the rate of damping with increase of pressure. (Pistons with rings)
Temperature: Atmospheric
Rate of damping = ·0074 radian per Oscillation
Air pressure = 0
Rate of damping = ·0079 rad./Osc.
Air pressure = 20 lbs/in²
Rate of damping = ·0098 rad./Osc.
Air pressure = 60 lbs/in²
Rate of damping = ·0087 rad./Osc.
Air pressure = 40 lbs/in²
Rate of damping = ·0110 rad./Osc.
Air pressure = 80 lbs/in.
TIME IN SECS. (1 OSCILLATION TAKES 4 SECS.)
ANGLE OF SWING OF PENDULUM IN DEGREES
Temperature: 100°C
Rate of damping = ·0071 rad. per Oscillation
Air pressure = 0
Rate of damping = ·0088 rad. per Osc.
Air pressure = 20 lbs/in²
Rate of damping = ·0112 rad. per Osc.
Air pressure = 60 lbs/in²
Rate of damping = ·0102 rad. per Osc.
Air pressure = 40 lbs/in²
Rate of damping = ·0131 rad. per Osc.
Air pressure = 80 lbs/in.
"THE ENGINEER"
SWAIN Sc

FIG. 2

## RESULTS OF TESTS.

A series of experiments carried out by Mr. P. L. Thorpe, of the Laboratory staff, gave the following results :—

*Series I.*—Friction of piston and rings. Lubricant, castor oil at atmospheric temperature; pressure between pistons varied from 0 lb. to 80 lb. per square inch.

*Series II.*—Friction of piston and rings. Lubricant, castor oil, with the cylinder walls maintained at 100 deg. Cent., and the air pressure varied as in Series I.

The rates of damping taken from the recorder are shown in Fig. 2.

It will be seen that in all cases—

(1) The rate of damping at any given pressure is independent of the amplitude of the swing, thus indicating a state of solid friction.

(2) The rates become greater as the pressure is increased, thus indicating an increase in friction with load.

Since the rates of damping are uniform, the values of the friction can be calculated from the expression $4.F.r./W.L.$ = rate of damping in radians per complete oscillation, where W is the weight of the pendulum, L its radius, and $r$ is the distance from the axis of the point of application of F the friction.

The results of both series of tests are given in Table I., in which are also tabulated the observed pressures at the back of the piston rings.

TABLE I.

| Pressure (gauge), lb./in.² | Rate of damping (radians per oscillation). Temp. Atmos. | Rate of damping (radians per oscillation). Temp. 100° C. | Friction in lb. Temp. Atmos. | Friction in lb. Temp. 100° C. | Pressure behind piston rings; lb./sq. in. (at all temperatures). No. 1 | No. 2 | No. 3 |
|---|---|---|---|---|---|---|---|
| 0 | 0.0074 | 0.0071 | 16.8 | 16.0 | 0 | 0 | 0 |
| 20 | 0.0079 | 0.0088 | 18.0 | 20.0 | 18 | 16 | 2 |
| 40 | 0.0087 | 0.0102 | 19.6 | 22.8 | 39 | 36 | 5 |
| 60 | 0.0098 | 0.0114 | 22.0 | 25.6 | 60 | 56 | 8 |
| 80 | 0.0110 | 0.0132 | 24.8 | 30.0 | 79 | 75 | 18 |

It will be seen that the air pressure at the back of the ring increased with the load in such a way that in the case of the ring nearest the cylinder head the pressure was sensibly equal to that in the space between the pistons. In the case of the second ring, the pressures were slightly less than in the first, and in the case of the third ring the pressure was relatively small, indicating that the common practice of using not more than three rings is fully justified.

It is noteworthy that the frictional resistance at atmospheric pressure was still considerable, and of the order of 16 lb. This is due partly to the pressure exerted on the cylinder walls by the elastic spring of the rings and partly to the friction of the piston itself.

The ring pressure can be calculated from a formula due to Professor Perry on the assumption that the rings are machined in the correct manner to give a uniform radial pressure. On this assumption, $p = \frac{f}{r}$, where $f$ is the force required to bring the ends of the ring together and $r$ is the radius.

For the rings used, which were .193in. wide and 1.89in. in radius, the value of $f$ was found to be 6.95 lb., from which $p = 3.68$ lb. per inch length of ring, or 19.1 lb. per square inch of ring surface. For the six rings, the pressure on this assumption would be 262 lb., which may be added to the observed pressures at the back of the rings due to the air pressure.

The variation of friction with radial pressure is shown for both temperatures in Fig. 3. It will be seen that what may be called the residual friction,

# THE MAIN ENGINE ROOM OF THE MOTOR LINER AORANGI

THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GOVAN, GLASGOW, ENGINEERS

*(For description see page 72)*

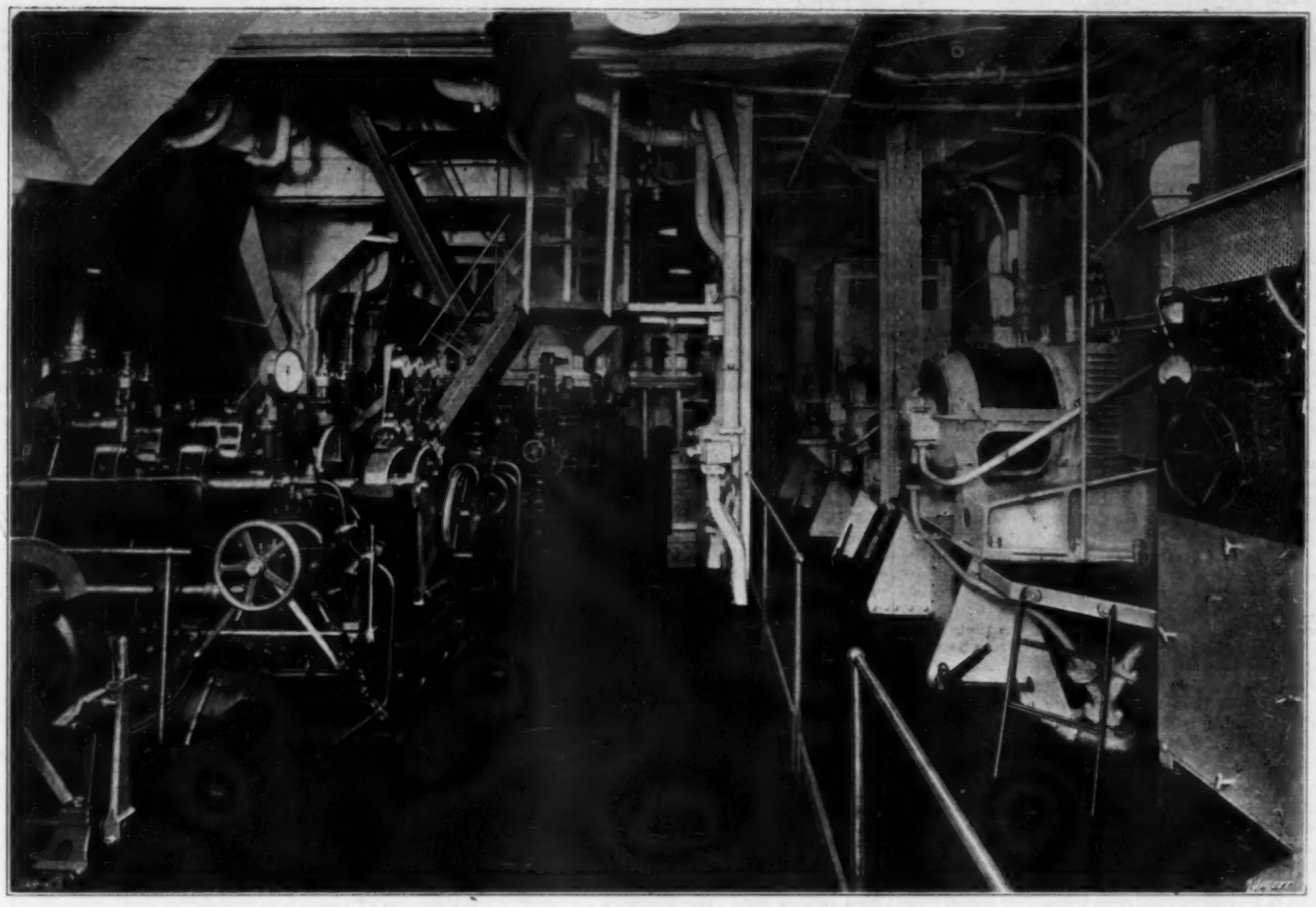


FIG. 19—FORWARD END OF TOP PLATFORM SHOWING TURBO-BLOWER MOTORS

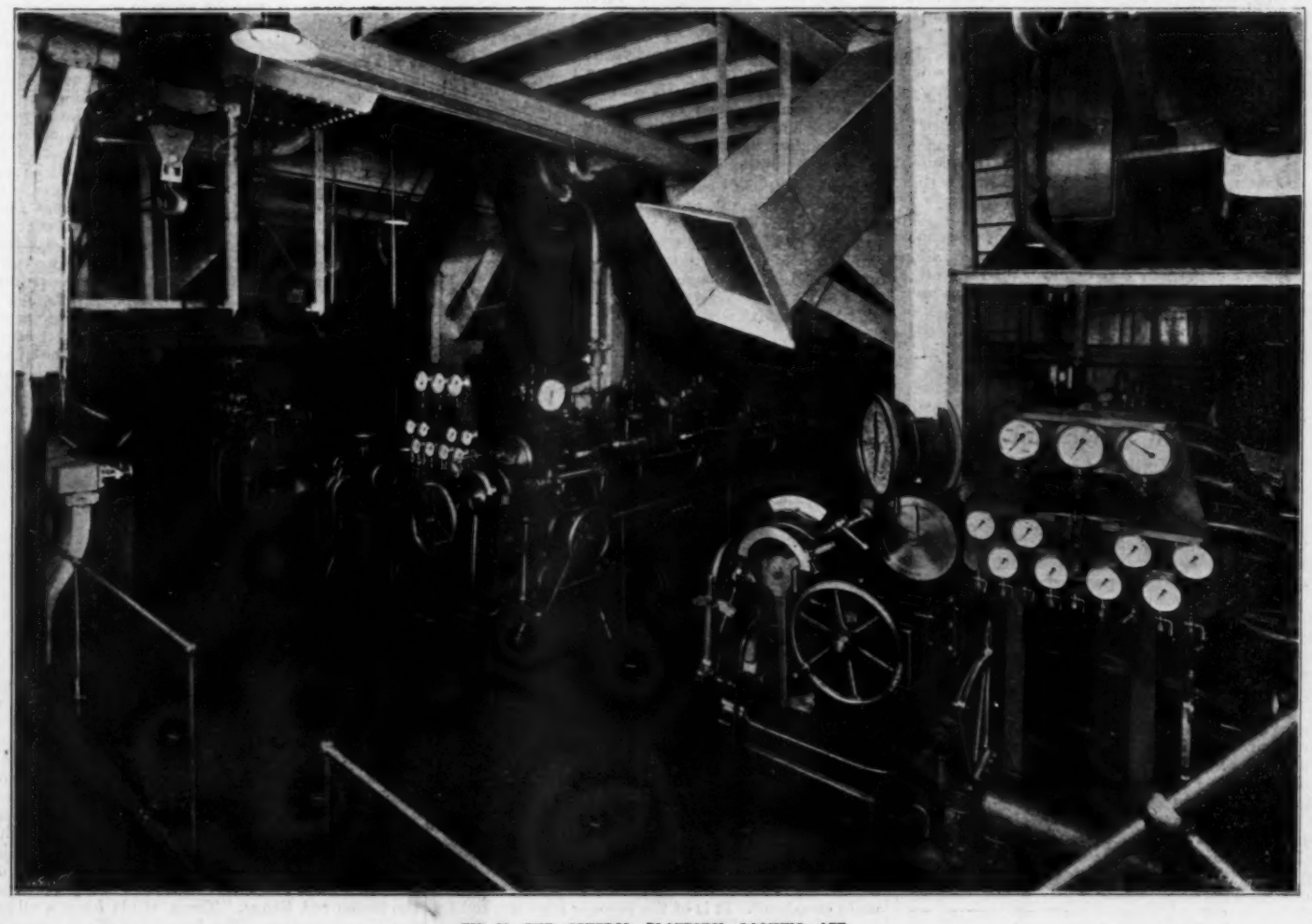


FIG. 20—THE CONTROL PLATFORM, LOOKING AFT

due to the pistons alone, is still considerable, and is more than would be expected from the fact that the side thrust of the pistons against the cylinder walls due to the obliquity of the connecting-rods was in this case negligible and, further, the piston clearance was large—.027in. It will be seen later, however, that in the case of experiments upon the friction of pistons alone, the existence of an oil film between their surfaces and the walls was indicated, and the residual friction appears to be due to the viscosity of this film, and probably to some extent to an under-estimation of the pressure of the rings by the use of the Perry formula.

The coefficients of friction for the rings is approximately .028 for the high temperatures and .023 for atmospheric temperature, which are remarkably low values for cases of boundary lubrication.

*Series III.*—Friction of pistons alone.

For this purpose two ringless pistons were fitted to the apparatus, the diametral clearances being 0.003in., as it was not considered that satisfactory results could be obtained from the original pistons of Series I. and II., which had a clearance of .027in.

Typical damping curves at different air pressures and temperatures of the cylinder wall are shown in Fig. 4. It will be seen that in the two tests at atmospheric pressure, and in the test at 80 lb. per square inch and atmospheric temperature, the characteristics of the resistance are quite different from those observed in the case of pistons fitted with rings, in that the rate of damping is no longer uniform and indicates the existence of a film of finite thickness between the surfaces. It is of interest to note that at atmospheric temperature the friction with a pressure of 80 lb. is actually less than at atmospheric pressure. The explanation appears to be that owing to the air leakage past the pistons in the test at 80 lb. pressure, the pistons were floating on a film of considerably less viscosity than that due to the oil alone. On the other hand, when the temperature is 100 deg. Cent. and the viscosity of the oil much reduced, the pressure of the air appears to have driven all the oil from between the surfaces, and the conditions then do not seem to have been favourable to the formation of an air film, with the result that the surfaces moved over each other in a condition of boundary lubrication.

### CONCLUSIONS.

From the results of the experiments, it appears that the lubrication of piston rings is of the boundary type, and that their frictional resistance will depend on the normal pressure between the rings and the cylinder wall. It is clear, therefore, that any device which will prevent the leakage of the gas or steam from the back of the piston to the space behind the piston rings will improve the mechanical efficiency of the engine. As regards the piston, it may be assumed that in all cases in which there is an appreciable side thrust due to the obliquity of the connecting-rod, the frictional resistance of the piston will also be proportional to the load.

In the experiments here described it may be remarked that the friction of the rings is only a small fraction of the total pressure on the piston; thus, at a pressure of 80 lb. per square inch, the ring friction of a single piston was of the order of 9 lb., which is only 1 per cent. of the total pressure on the piston. Assuming the same value of the coefficient of friction for the piston as for the rings, it would appear that in ordinary internal combustion engine practice if the lubrication were as efficient as in the experiments, the maximum friction of the piston and rings would be of the order of 3 per cent. of the mean pressure on the piston. This is thought to be lower than the value commonly assumed for piston and ring friction, and is probably due to the relatively greater efficiency of the lubrication in the experiments compared with that which exists in practice.

## The Motor Liner Aorangi.

No. III *

### MAIN PROPELLING MACHINERY.

ALTHOUGH there is much that is interesting in the many problems associated with the design of a large liner, such as those connected with the laying out and equipment of the passenger accommodation and the installation of the numerous mechanical appliances employed in navigating and working a modern ship, the centre of attraction to the engineer is always the main propelling machinery. In the Aorangi we have a quadruple-screw liner propelled by internal combustion engines of a larger total output than has yet been installed in any ship, and the interest to the engineer is therefore even greater than usual.

The main propelling machinery consists of four sets of six-cylinder Fairfield-Sulzer marine oil engines, designed to work on the two-stroke single-acting principle. Sectional drawings of one are given in to-day's Supplement, and views of the engine-room, Figs. 19 and 20, showing the control platform are reproduced on page 71. The scavenging air required is supplied from three separate electrically driven turbo blowers, the motors of which are seen to the right of Fig. 19. Each of the main engine cylinders is 27½in. diameter. The stroke is 39in., which gives, when the engine is running at its normal speed of 127 revolutions per minute, the moderate piston speed of 825ft. per minute. The total indicated horse-power of the four engines is 17,000, corresponding to 13,500 shaft horse-power. During the shop trials of the first engine—particulars of which were given in THE ENGINEER of March 21st last—a fuel consumption of 0.392 lb. per brake horse-power was obtained, and this figure is remarkably close to the consumption of 0.395 lb. for the four main engines during the sixty hours' sea trial under full-load conditions. It may be remarked that the speed of rotation is a little higher than that employed in some other ships fitted with Sulzer type engines. It was fixed by considerations of propeller efficiency and freedom from torsional vibration. In our first article we made mention of the high propulsive coefficient of over 0.58 obtained with the propellers running at 125 revolutions during the trial runs, whilst a marked feature of the same trials was the absence of vibration in the ship. The care taken by the builders in fixing the engine speed would thus appear to have fully justified itself.

In addition to mathematical calculations, an investigation of the out-of-balance forces was made by means of a special torsiograph designed by Sulzer Brothers. The results and torsiograph diagrams showed that with six cylinders, with the cranks set at 60 deg.—due allowance being made for the 9-ton fly-wheel and the tail shaft—an arrangement remarkably free from out-of-balance forces and disturbing couples was obtained, so much so that the first engine was run at about 20 per cent. overspeed for some hours with excellent results, no marked vibrations being indicated by the torsiograph. Another factor which contributed towards the good running of the main engines was the care which was taken in designing their seatings, and the bed-plate and columns. The builders rightly attached great importance to securing a firm connection between the main bed-plate and the ship structure. For this reason special consideration was given to the depth, strength, and construction of the girder work in the double bottom tanks beneath the engines. These tanks are shown in Fig. 23. The girders, which are about 5ft. 6in. deep, are so dimensioned that the load of the engines is equally distributed to the hull.

### THE ENGINE DESIGN.

*The Main Bed-plate.*—Not less important than the preparation of adequate engine seatings are the modifications to the usual design of bed-plate which were carried out. The Fairfield Company departed from the general continental practice of bolting the engine bed-plate to girders built on the tank top and decided to use a flat sole-plate bolted directly to the tank top. The design of bed-plate adopted and the arrangement of the centre oil trays and main bearing supports may be noted from the drawing reproduced in to-day's Supplement and those given on page 73. We may also mention that the bearing surfaces of the crank shaft and the connecting-rod top and bottom ends are liberally dimensioned so as to give a moderate working pressure which is likely, with the absence of vibration, to contribute to a long life of the running parts.

*Crank Shaft and Connecting-rods.*—The main crank shaft, which is shown in the drawings referred to, was forged from a special steel of 31 to 35 tons tensile strength, and has a diameter of 19in., which gives an ample margin over the size required by Lloyd's formula. It is of the semi-built up type, the crank pin and its adjoining webs being forged in one piece, whilst the shafts with the main bearing journals are shrunk into position. In addition to the shrinking, two large dowel pins are fitted between each web and the corresponding journal. Before driving, these pins were eased in a radial direction so as to ensure a firm shrinkage grip and were then forced home with a 100-ton hydraulic jack.

At the forward end of the shaft two cranks placed at 180 deg. drive the two air compressors. The high-pressure piston of each compressor is 5½in. in diameter with a stroke of 20in., common to all three stages. The cylinders are so arranged that the high and low-pressure pistons compress the air on the up stroke, while compression in the intermediate stage takes place on the down stroke. Note may be taken of the very neat way in which the suction and discharge valves are housed in the cylinder walls and above the high-pressure pistons, so that minimum clearance is obtained. The compressors are water cooled and intercoolers of the straight tube type are provided for each stag. The suction air may be taken from the inlet air trunk provided for the turbo-blowers, or if more air be required, from the scavenge air delivery main at an initial pressure of 1.80 lb. to 2.0 lb. per square inch. Each of the two compressors is designed to supply sufficient injection air for one main engine running at full power, but by taking the suction air from the turbo-blower delivery main an increase in output approximating to 12 per cent. can be obtained.

The only pump which is driven directly from the crank shaft is the lubricating oil pump supplying the main crosshead. It is of the plunger type worked by an overhung crank on the air compressor crank shafts. This pump takes its suction supply from the main lubricating system and delivers oil to the crossheads at a pressure of 250 lb. per square inch.

Returning to the after end of the main crank shaft, we may remark upon the robust arrangement of the vertical shaft skew gear drive and the neat manner in which the fly-wheel is enclosed and coupled to the turning gear. On the outer rim of the fly-wheel spur teeth which engage with the pinion of the turning engine are cut. The fly-wheel is provided with a circular index plate, which may be used to check the valve settings. The crank shaft is turned by a small two-cylinder compressed air servo motor, which is identical in design with that used for reversing and manœuvring the main engines. At the end of the bed-plate and attached to it is a thrust block of the familiar Michell type, while at the extreme forward end of the crank shaft a small gauge is fitted to measure any wear on the thrust pads.

*Columns and Crank Casings.*—The cast iron main columns are built in girder section with a stiff upper plate, to which the cylinder casings are secured by studs and nuts. Each set of columns is provided with four guide facings to take the thrust of the main connecting-rod. The guide plates are also made in cast iron and are of box section bolted direct to the columns. Provision is made for cooling the guide faces by oil which flows through internal cooling spaces and for the lubrication of the same surfaces by means of a by-pass jet connected with the cooling space. A section through these guides is given in the plan drawing reproduced in the Supplement, and the elevation clearly shows the telescopic pipes used to convey the lubricating oil to the main crosshead journal. The neat arrangement of the fittings carrying the pipes with their air vessel over the main bearing cap may be noted. Care was taken to make the crosshead journals for the top end of the connecting-rod of ample size, and although the top end bolts are not normally in tension, they were designed to take up the maximum load due to the inertia of the reciprocating parts when there is no compression in the cylinder space. The drawings referred to and those reproduced on page 73 indicate the arrangement of the piston cooling water connections, which are so designed that the piston crowns are always drowned with cooling water. Open drains are arranged between the inspection doors on the crank casing and are fitted with thermometers, which enable the attendant to note the temperature at which the cooling water leaves the piston. Reference may also be made to the large planished steel hinged doors at the front and the back of the engine. They give easy access to the running parts of the engine and will greatly facilitate any inspections or overhauling work. For the purpose of immediate inspection smaller circular doors are also fitted slightly above the centre line of the casing.

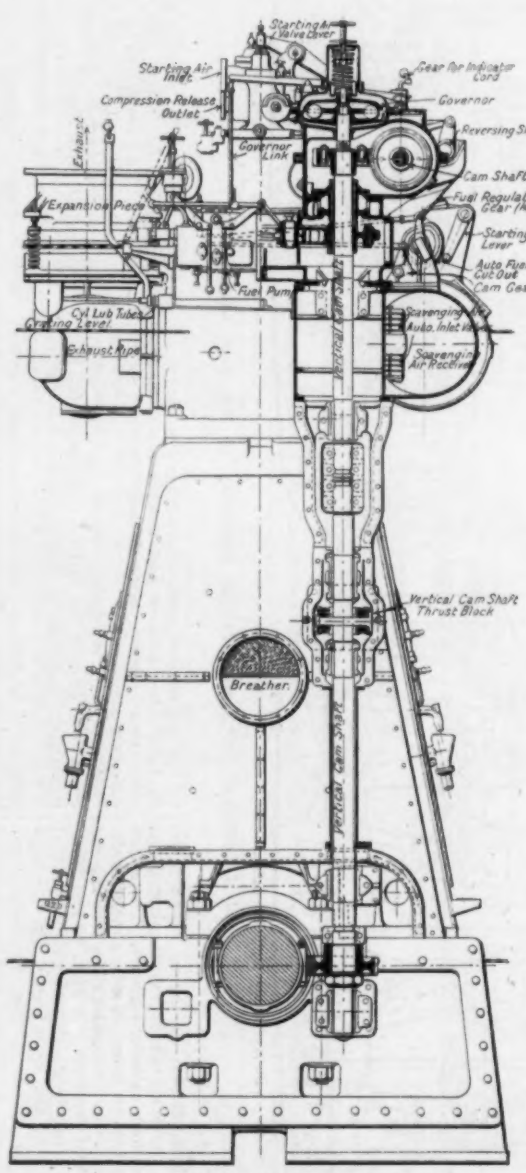
*Cylinder Casing, Liner, and Piston.*—The sectional elevation given on page 73, taken in conjunction with the sectional views reproduced in the Supplement, make clear the detailed construction of these parts. It will be seen that the cylinder casings are particularly massive, indeed they weigh something over 5 tons each. On opposite sides of the cylinder are the scavenge air inlet and the exhaust gas outlet ports, while the space between the casing and the liner forms the cooling water jacket. The arrangement of the scavenge ports should be observed. It will be seen that they are in duplicate, one placed directly over the other. The lower ports are uncontrolled and admit scavenging air to the cylinder as soon as they are uncovered by the piston, but automatic scavenging valves control the upper series of ports. These valves do not allow any communication to take place between the cylinder space and the scavenging air receiver on the down stroke of the piston, but on the up stroke they admit air to the cylinder and continue to do so after the lower ports have been closed by the piston. By this means a supercharging effect is obtained, which experiment has shown greatly increases the power developed in a given size of cylinder. Five groups of six valves are fitted to each cylinder, but they are of the flat disc type, and require practically no attention. This new design is a considerable improvement on the rotary scavenge valve positively driven from the vertical shaft which was fitted to earlier Sulzer type engines.

The main liner is made of a special cast iron, and is in the form of a plain cylindrical casting. The bars through the exhaust and scavenge ports are water-cooled. The liner is pressed into the cylinder casing, and is free to expand downwards, whilst its top in the combustion space is given sufficient clearance to enable it to expand in a radial direction. Oil scraping rings are fitted to the bottom of the liner to prevent any excess lubricating oil from the crank case reaching the liner, where it would be carried out through the exhaust ports. The water-tight joints between the cylinder casing and the liner are formed with copper rings and rubber rings. The piston head is made of a special heat-resisting cast iron. The crown is specially ribbed, so that the head can expand in all directions. Seven Ramsbottom rings, which are free to rotate, are fitted. The piston skirt, which covers the lower ports, is of comparatively light section, but is supported by strong central ribs and secured to the head by long studs, which also carry the piston-rod flange. These studs form a slightly flexible connection. The lower end of the piston-rod

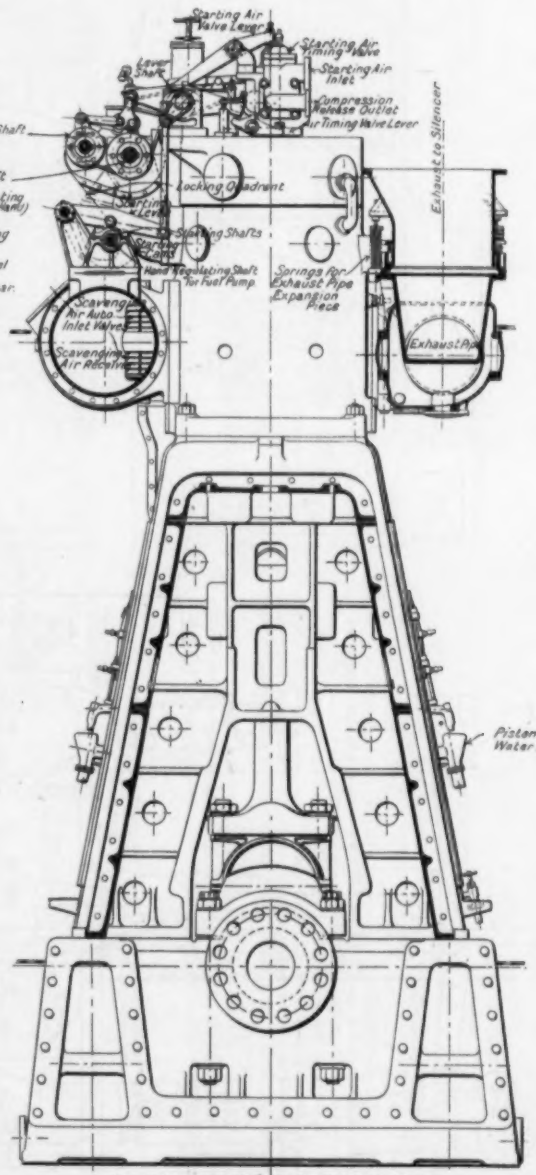
* No. II. appeared January 9th.

# THE MAIN ENGINES OF THE QUADRUPLE-SCREW MOTOR LINER AORANGI

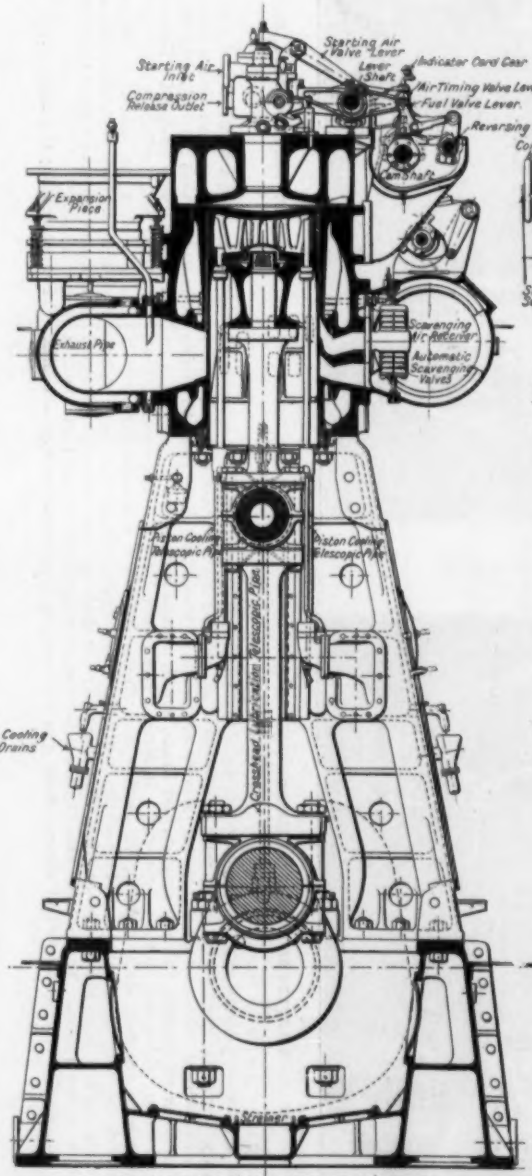
THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GOVAN, GLASGOW, ENGINEERS



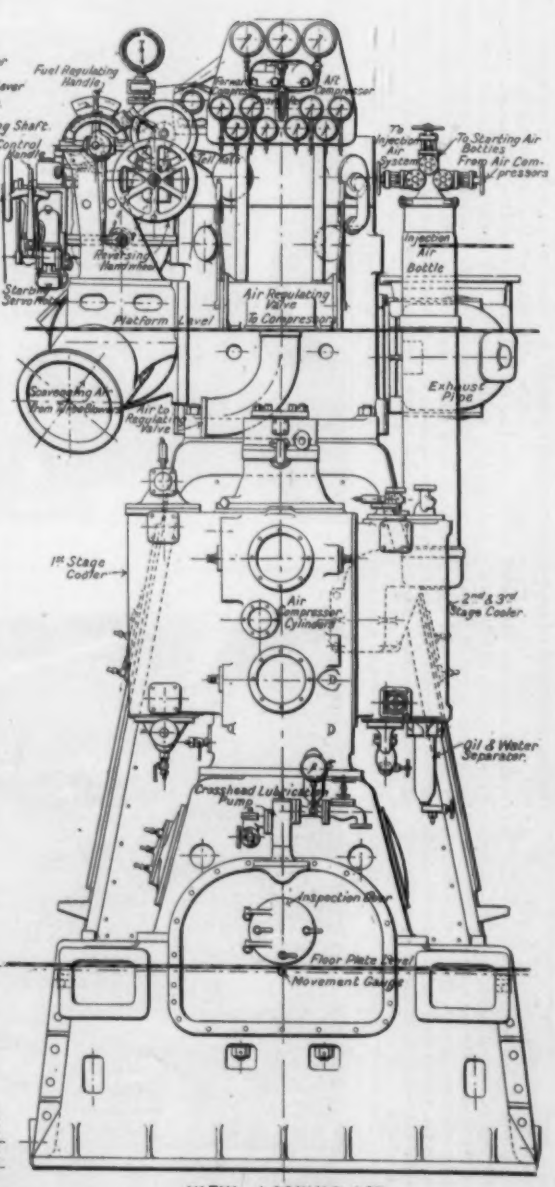

SECTION THRO' VERTICAL CAM SHAFT DRIVE.
"THE ENGINEER" LOOKING FORWARD




SECTION THRO' CENTRE OF ENGINE.
LOOKING AFT.




SECTION THRO' WORKING CYLINDER.
LOOKING FORWARD




VIEW LOOKING AFT.

SWAIN SC.

is attached by bolts to the cross head, which is made of a high-tensile steel.

*Cylinder Cover and Valve Gear.*—A simple type of cylinder cover, with a single central valve opening, is a prominent feature of the Sulzer design, and as such is familiar to our readers. It also is clearly illustrated in the drawings we reproduce. The cylinder cover itself is secured to the casing by a series of heavy studs, the joint between the cover and liner being made with a serrated spigot and copper jointing ring. The central water-cooled valve chest is designed to incorporate the fuel valve and starting valve, with an indicator cock. The non-return air-starting valve is attached to a balanced air-timing valve, and all the valves are worked by levers from the cam shaft. During the manœuvring period, the starting air valve is held open and compressed air is admitted to the cylinders on the downward stroke of the piston. This same valve also acts as a compression release valve, and allows the air which is compressed on the up stroke of the piston to be by-passed into the scavenging air receiver, so relieving the main cylinder pressure. The actual manœuvring is done by means of a twin cylinder air-operated servo-motor, arranged at the forward end of the engine, and illustrated in Figs. 19 and 20 on page 71. By moving the starting lever air is admitted to the cylinders of the servo-motor, which rotates the starting shaft, and so operates the valve levers that all six cylinders are put on starting air, whilst the compression release valves are held open. Further rotation of the starting shaft puts three cylinders on fuel, the other three remaining on air, while still further movement places all the six cylinders on fuel. A marked dial, in full view of the operator controlling the manœuvring of the engine, shows the number of cylinders on air and fuel. The action of the servo-motor is quite automatic, and the operation just described only takes a few seconds to complete. The progress of these operations may, however, be accelerated or retarded by the starting lever, which admits air to the servo-motor. This lever has three positions, ahead, neutral and astern.

Reversing is effected by a hand-operated wheel, which, through the medium of worm gearing, controls the swinging lever which carries the cam rollers. There are two pairs of air and fuel cams, one for ahead and one for astern, placed side by side on the cam shaft, and the swinging lever transfers the cam roller to the appropriate cam, after which the engine is started in the manner just described. The valve gear is clearly shown on the sectional drawings reproduced on page 73.

Other points of design, which we may briefly touch upon concern the vertical shaft drive, the fuel pump and the governor. A new feature of this drive is the provision of a standard Michell thrust bearing, which will be seen on the aft column half-way up the vertical shaft. The arrangement of the cam shaft and fuel pump drive is shown in the left-hand view on page 73. This figure also shows a section through the centrifugal governor which controls the output of the fuel pump. This pump is fixed just above upper platform level at the after end of the engine, and has six opposed plungers. The amount of oil delivered to the cylinders is regulated by controlled suction valves, which are operated by tappets mounted on an excentric fulcrum. The position of this fulcrum can readily be adjusted by the engineer on duty, a lever with fine notch adjustment being provided for that purpose. By this means the speed can be regulated by hand. The engines driving the outer and inner propellers are arranged to develop equal powers at slightly different speeds, thus obviating any possible trouble which might arise from synchronism in the running speeds of the four propeller shafts.

For lubricating the engine cylinder liners, the air compressors, and other running parts of the valve gear, forced feed lubricators with a visible discharge are provided. They are driven by excentrics mounted on the cam shaft, and the same excentrics serve to work the indicating gear. Indicating cocks are fitted on the central valve chests.

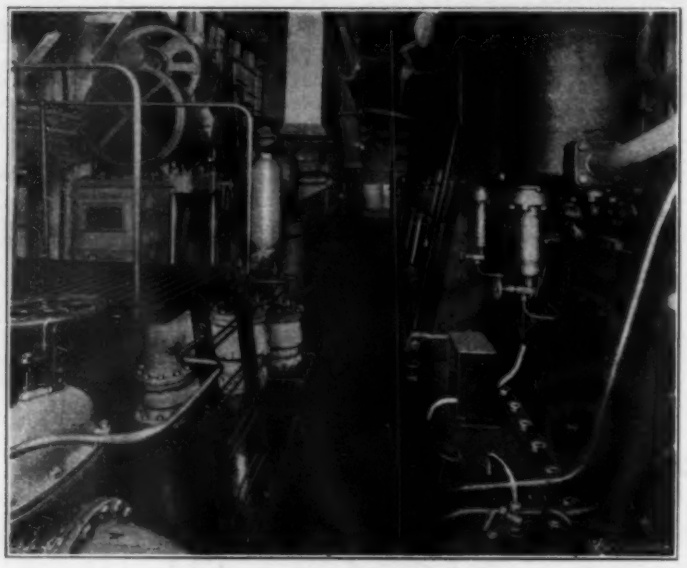


FIG. 21—MAIN ENGINE AND AUXILIARIES

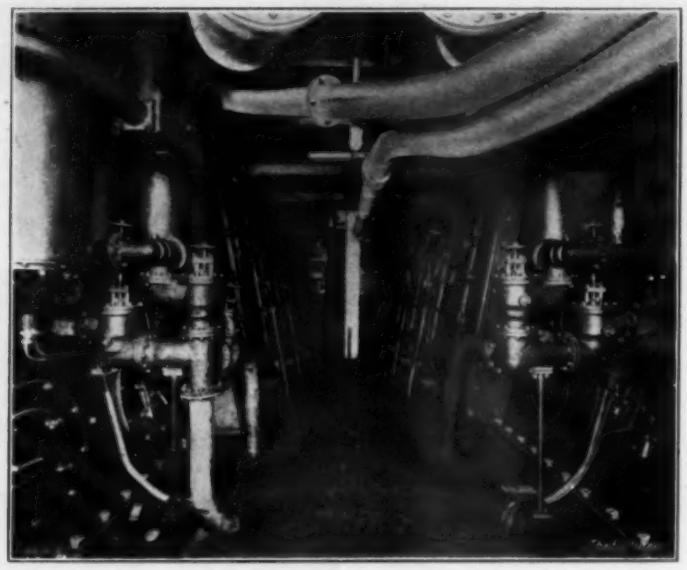


FIG. 22—BOTTOM PLATFORM BETWEEN PORT ENGINES

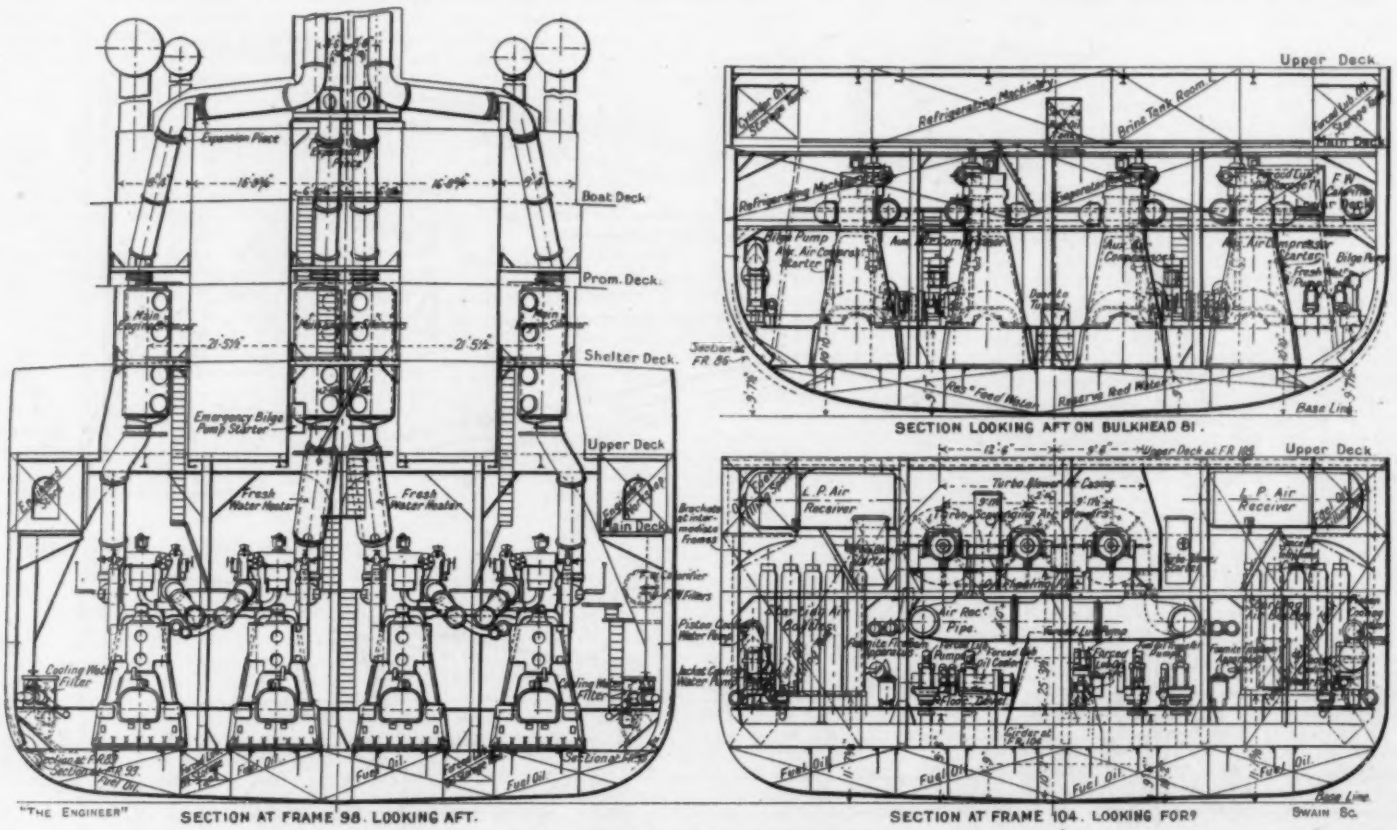



FIG. 23—SECTIONAL VIEWS SHOWING THE MACHINERY IN THE MAIN ENGINE ROOM

### THE MAIN CONTROL PLATFORM.

It is customary in nearly all Sulzer-engined ships to arrange the starting and running controls at top

platform level, where the engineer on watch has a full view of the valve gear and other important parts. The advantages of this system, which on the Continent is also gaining favour with other types of engines, have never been better exemplified than in the case of the vessel we are describing. The two illustrations which we reproduce on page 71 show very clearly the roomy character of the forward end of the top control platform, from which an extensive view of the four engines is obtained. Fig. 19 is a view taken looking towards the port side of the ship, and to the right will be seen the three electric motors, which drive the turbo-blowers for supplying the scavenge air. We shall refer to these in detail later. The other view—Fig. 20—shows the same platform looking towards the engines, and the overhead runways with lifting gear may be noted. The wide platform forms an excellent space for carrying out any repairs during the overhauling of the engines. At the forward end of each engine will be seen the reversing hand wheel, servo-motor, starting lever and other running equipment, together with the starting and injection air receivers. In addition to the controls already mentioned, an emergency cut-out gear is provided on each engine, and is designed to operate as soon as the lubricating oil pressure at the crossheads falls below a predetermined minimum pressure. This control acts directly on the governor, which, through the fuel pump, stops any further supply of oil to the engine cylinders. Means are also provided for stopping all the engines from either the upper or lower platforms in the case of an emergency.

The controls have been so arranged that one engineer can conveniently attend to two engines at the same time. Tachometers and counters by Harding,

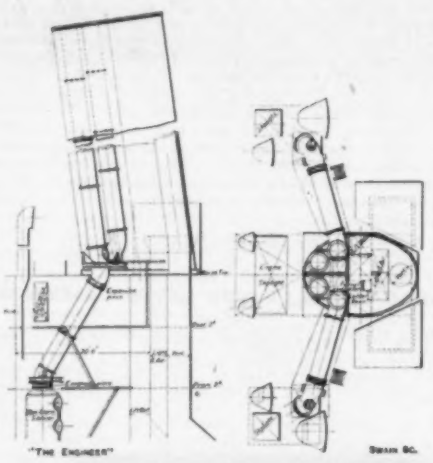


FIG. 24—EXHAUST PIPES IN THE AFT FUNNEL

Rhodes and Co., Limited, are fitted to each engine, as well as a tell-tale which shows the engine speed on the bridge. This tell-tale and also the engine telegraphs were supplied by A. Robinson and Co., of Liverpool. Views of the lower platform are given in Figs. 21 and 22. One shows the clear space between two of the main engines, and the other a port wing compartment with some of the auxiliary pumps. The free space giving easy access to the cylinder casing inspection doors may be noted. It will be appreciated that all the important parts of the engine are accessible from the top control platform, and from the lower platform only periodical attention for lubrication and for taking cooling water temperatures is required.

*Exhaust Pipe Arrangements.*—The drawing reproduced to the left of Fig. 23 shows in a very clear way the arrangement of the exhaust pipes, while a detailed drawing of the aft funnel, showing the grouping of the four exhaust pipes within it, is given in Fig. 24. The exhaust from the six cylinders passes into a water-cooled main at the back of the engines, which is connected to a rising main leading to the silencers. On the exhaust system of the two inner engines, heaters for fresh water are fitted. The main engine silencers are housed in the engine hatches and the arrangement is notable for the absence of bends and the free run of the pipes. The straight lengths of pipes are of steel, 19½in. diameter, but cast iron bends with inspection doors are used along with cast iron expansion pieces provided with sliding glands. At the engine itself the expansion piece is fitted with springs to prevent any vibration being transmitted to the pipe system. Fig. 24, already mentioned, shows the arrangement of exhaust pipes in the funnel itself. After leaving the silencer the pipes are carried up independently to a point flush with the top of the funnel.

With this arrangement, excellent silencing is obtained, and during the trials we noted very little noise, either on the top decks or in the cabin spaces adjacent to the engine hatches.

In the following article it is proposed to deal with the main engine auxiliary services and with the auxiliary machinery which is fitted in the main and the forward engine-rooms.

## 3-Wire Direct-current Distribution Networks.

A PAPER, entitled "Three-wire Direct-current Distribution Networks: Some Comparisons in Costs and Operation," was read on the 9th inst., by Mr. H. W. Taylor before the Institution of Electrical Engineers. The author showed that, whenever permissible, the most satisfactory network is that composed of single-core lead-covered cables, the feeders being drawn into conduits, whilst the distributors and services should be laid direct. From the point of view of operation the use of single-core cables for feeders is considered to be very satisfactory, as advantage can be taken of their high current-carrying capacity, and it is for this reason, the author explains, that some electricity undertakings have adopted this system even when part of the network is made up of three-core or triple concentric cables. The greatest advantage of single-core cables, the author contends, arises from the small amount of inconvenience caused to consumers under fault conditions, and this advantage is particularly well marked when the feeder system is followed up by a similar distribution system. Mr. Taylor considers that there is little to choose between the other two types of cables, any advantage resting with the three-core cable, for the maximum current-carrying capacity is rather higher than that of the triple concentric cable. Joints on three-core cables are also simpler, but this is not so important on feeders where there are comparatively few joints. On distributors, however, the fact assumes much greater importance. The use of three-core cables is limited to sizes up to 0.5 square inch, cable manufacturers being unwilling to guarantee larger sizes. This disadvantage is not shared by the triple concentric cable.

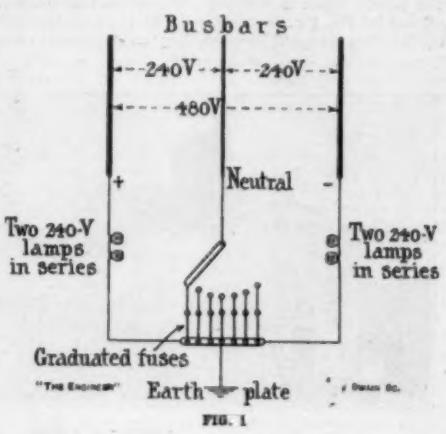



FIG. 1

A section of the paper is devoted to methods of laying cables. In dealing with the scheme of laying cables direct the author remarks that a fact that soon becomes apparent when laying cables in accordance with this system is the ease with which such work can be carried out. There is no need for the same amount of preliminary caution to be taken as for laying a conduit track along a main road. The fact that an obstruction is easily passed by this method is often a deciding factor in its favour. The life of a lead-covered cable laid in good ground, such as clay or sandy soil, has not yet been determined, but the fact that such cables on being examined after fifteen or twenty years' service show no signs of deterioration would appear to indicate that their useful life is very considerable.

For feeder work full advantage can be taken of the high maximum permissible loading of the direct-laid cable. This might in some cases enable a smaller size of cable to be used than if it were to be laid solid or drawn into conduits.

Two factors have to be borne carefully in mind when laying cables direct, viz:—(1) Electrolytic action due to stray currents from other sources; (2) the corrosive action of certain kinds of ground.

In dealing with the "solid system" of laying cables, the author explains that practically the only occasions on which this system is used to-day is when local chemical or electrolytic action would be probable on a cable laid direct. Even when such a course is adopted, plain lead-covered cable is preferable to the vulcanised-bitumen sheathed cable. The first cost in laying down a feeder, the author points out, is not the only consideration. When provision has to be made for future extensions and when the cost of repairing faults in cables laid under certain types of roadway that are both expensive to excavate and to reinstate is borne in mind, a considerable ultimate saving will be effected by incurring the increased initial cost of the conduit system.

A simple earthing device for use in the station is dealt with. Referring to Fig. 1, when an earth occurs on one of the "outers" it simply blows the light earthing fuse, and the neutral and other outer are respectively raised or lowered to 240 volts and 480 volts above or below earth potential, as the case may be. The system will therefore continue to operate with one of the outers earthed instead of the neutral. This condition cannot, however, be allowed to continue indefinitely, as the Electricity Commissioners stipulate that such a fault must be cleared within twenty-four hours. The allowance of so short a time is due to the fact that, whilst it involves no danger to the electrical system, there is a greater risk of shock from the higher potential at which the unearthed pole is then operating.

This arrangement offers no relief to the network when a fault takes place between cables, and for this reason it is not advisable to run the network without any fuses at all. The difficulty is overcome by installing a few heavy network fuse boxes at certain points, their exact position being determined by the lay-out of the particular network.

By employing a cable in which there is a thin copper testing strip, as shown in Fig. 2, and lightly insulated from the lead sheathing, it is possible to locate a fault without actually cutting the core, which means that there is no need to disconnect the faulty cable until the fault has been found and everything is ready for carrying out the repair. The value of the strip as an aid to fault finding is based upon the assumption that wherever a fault occurs from the core to earth, the strip will be brought into contact with either the core or lead covering, or perhaps both. By testing to earth at the terminals T the faulty strip can be located, and by cutting the strip as, for example, at $S_1$ and $S_2$ and testing both ways, the fault may be found without interrupting the supply or cutting the cable.

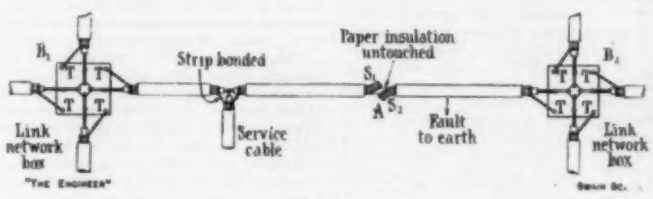



FIG. 2

Whilst dealing with distributors the author puts forward a suggestion which is considered to facilitate the location of faults on vulcanised bitumen triple concentric distributors up to about .2 square section and which will help to preserve the continuity of supply under fault conditions. As faults on modern cables are generally attributable to external causes, the majority of faults on triple concentric distributors are between the middle and outer cores, *i.e.*, between the negative and neutral, and it follows that it is only necessary to cut the neutral core to enable a test to be made that will show in which direction the fault lies. If, then, the neutral of the distributor is looped in at several of the services along its length, as shown in Fig. 3, a convenient method of breaking its continuity is provided without any excavation being necessary.

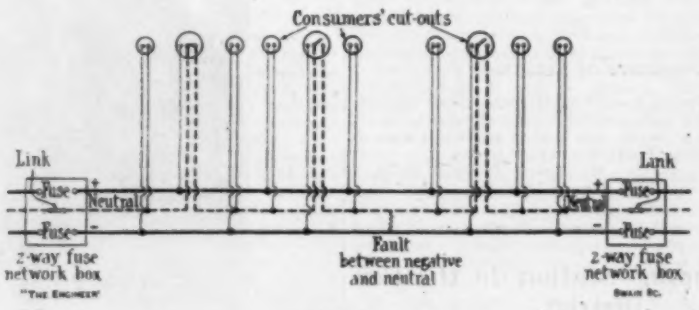



FIG. 3

Obviously, when a fault has been traced to a position between two consumers in whose premises the neutral is disconnected the supply can be restored to all the consumers with the exception of those tapped off the faulty length. If the fault be between all three cores the positive and negative should be bridged at the network box and only one fuse should be replaced.

The foregoing is but a very brief outline of this useful paper, which is well worthy of the attention of mains engineers. The authors' main conclusions as regards the various types of cables and methods of laying are as follows:

*For Feeders.*—(1) Three single plain lead-covered cables drawn into water-tight earthenware conduits. (2) Where future load has not to be provided for and where the feeder can be laid in good soft ground and free from the danger of electrolysis, three single armoured cables laid direct would be suitable. (3) Where the authorities have not much road space available, a three-core lead-covered

cable may be drawn into conduits, but it would forfeit the special advantages of single-core cables. Where a multi-core cable is desired larger than 0.5 square inch by 0.25 square inch by 0.5 square inch, a triple concentric cable is necessary.

*For Distributors.*—(1) Three single lead-covered steel-tape-armoured cables laid direct with tile covering. In a locality where there is a danger of electrolysis, plain lead-covered cables should be substituted for the armoured cables and laid solid in separate earthenware troughing with tile covering. (2) Where the feeder system is three-core or triple concentric, three-core distributors could be used, as most of the advantages of single-core distributors depend upon the whole system being made up of a similar type of cable. Triple concentric distributors should be avoided.

*For Services.*—A type of cable similar to that used for the distributors. If the distributor is laid solid it is often more convenient to lay armoured services direct in the ground.

## Letters to the Editor.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### ROBERT STEPHENSON.

SIR,—The reference to Jeaffreson's "Life of Robert Stephenson," in your issue of January 2nd, page 27, under the heading "Sixty Years Ago," is of great interest to one who has had to consult it, particularly for its evidence on the history of the locomotive. It is quite as disappointing in this respect to this day, and in a general sense, as your reviewer found it to be sixty years ago.

When one reflects on the original material at the disposal of its author, one may well weep for his lost opportunities; for practically the whole of the historic correspondence between the two Stephensons, 1825–1830, from which Jeaffreson quotes, has disappeared. Moreover, he did not reproduce a single one of the original drawings relative to controversial points, and, where he has given judgment on such points, he has sometimes erred.

As for his general portrait, he certainly wrote at a time when biographers were disposed to look at the faults of their subjects, through a telescope rather than through a microscope, as we do to-day; but, even so, was he wrong in holding that Robert Stephenson was a genius? That surely depends on the definition of the term—always a question of some difficulty.

And was your reviewer right in considering Robert Stephenson "lacking in the ability to push aside obstacles that (might have) prevented his rise?" A perusal of the letters which he wrote as a young man of twenty to twenty-three, when in charge of a mining expedition in America—letters which have fortunately been preserved in the Illingworth family—and, later, his accomplishment of the London and Birmingham Railway in the face of great difficulties, does not support such a view.

Certainly he was handicapped by a natural modesty and a tendency to despondency, due, I gather, to physical causes, which made him a less effective fighter than "Old George." He was indeed a "natural English gentleman" of a type which is bound to suffer at first in its dealings with less scrupulous men; but the trust and affection which he inspired had their reward, and the charm of his gracious personality has affected even one who has learnt to know him only through his work and letters, or from the lips of an old lady, still living, who, as Miss Bidder, the daughter of the famous George Parker Bidder, accompanied Robert Stephenson on his last voyage to Egypt, and met there his pupil Stanton, whom she afterwards married.

It is obvious now that Robert Stephenson's technical conclusions—shared by some other eminent engineers—on the practicability of the Suez Canal were wrong; but it seems clear from such documents as I have read, that he was influenced by the fear that his countrymen might be involved in his name in a costly and ruinous adventure. Here perhaps his "genius" failed.

There has been much discussion lately whether on moral grounds another famous Englishman should be commemorated in Westminster Abbey. It is a curious coincidence that not long ago a protest was made in *The Times* against the disappearance of a stained glass window which had been erected to the memory of one whose title to such distinction was surely indisputable—Robert Stephenson.

J. G. H. WARREN.

Bath, January 12th.

### A HISTORY OF BUSINESS.

SIR,—I am collecting data for a "History of Business," and in order to make my book as complete and authentic as may be, I should be glad to receive from any old-established firms or organisations a concise description of their growth.

H. SPENCER STOWELL, M.S.A.

70, Victoria-street, S.W. 1, January 12th.

## New Pumping Station in the Fen District.

A NEW drainage pumping station was recently put into service at Manea and Welney in Cambridgeshire. The pumping in that district had previously been effected by means of a large scoop wheel driven by an old beam engine. The new plant, in which centrifugal pumps driven by internal combustion engines are employed, was designed by Major R. G. Clark, Assoc. M. Inst. C.E., A.M.I. Mech. E., the engineer to the Middle Level Drainage and Navigation Commission. It comprises two independent 36in. "Invincible" pumping units, made by Gwynnes Engineering Company, Limited, of Hammersmith Ironworks, London, W. 6, each driven by a four-cylinder hot-bulb engine, made by Vickers-Petters, Limited, of Ipswich. The pumps have cast iron casings, split along the horizontal line to facilitate inspection of the interior. The suction is in the lower half casing, and the discharge in the upper half, and special provision has been made to prevent clogging by reeds, &c. The engines, which are of the two-stroke type, have solid injection and run at 300 revolutions per minute, at which speed each engine is designed to develop continuously 180 brake horse-power, with fuel of a calorific value of not less than 18,000 B.Th.U. per pound, and a specific gravity not exceeding 0.9. The consumptions of such fuel at full, three-quarter and half load are given as being as follows:—

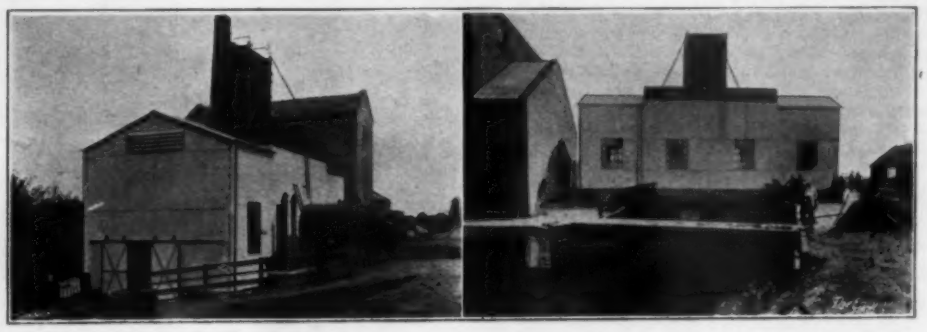
| | |
|---|---|
| At full load .. .. .. .. | 0.5 pints per B.H.P. hour. |
| At three-quarter load .. .. | 0.53 pints per B.H.P. |
| At half load .. .. .. .. | 0.6 pints per B.H.P. |

The two pumping units are designed to be capable of lifting, when operating simultaneously, 280,000 tons of water per twenty-four hours against a head of 17ft During the official trial there was not sufficient water to keep both units in operation, so that only one set was run at full power, when it reduced the level of the water in the sump by 2ft. 9in. in 1¼ hours. At the opening ceremony the time occupied from starting the engine from cold to the pumping set carrying full load was, we are informed, under three minutes.

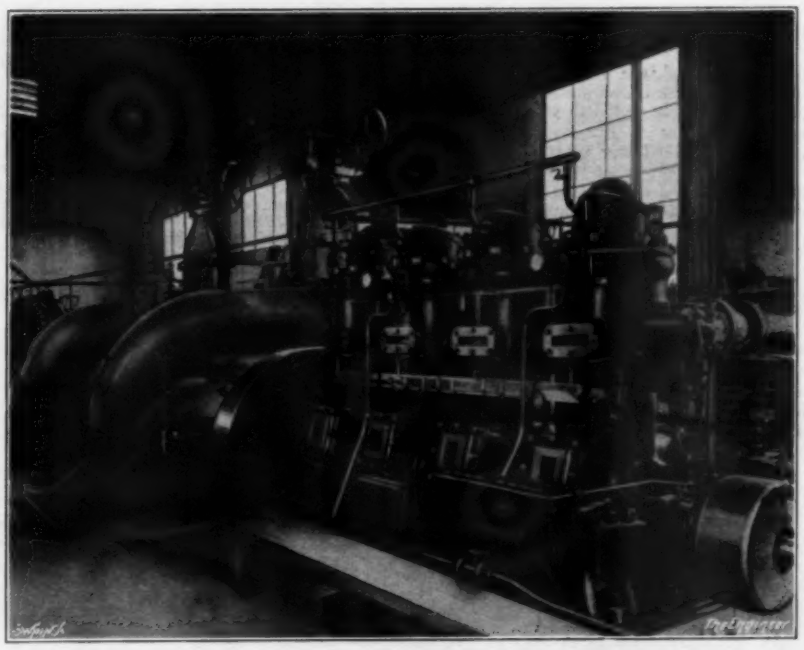
The pumping station, which is erected on a reinforced concrete deck, 18in. thick, carried on piles, consists of a steel-frame building panelled by a dwarf blue brick wall with corrugated asbestos sheeting above. There is a 5-ton gantry above the machinery to facilitate the lifting of inspection doors, &c. A diversion of the main drain, 26ft. wide, which is protected by a weed screen across the full width of the mouth, has been made to the new sump. The cooling of the water for the cylinder jackets is effected in a water tower mounted in a tank placed outside upon the roof. The fuel tanks are arranged outside the engine house in a position convenient for filling either from boats on the water or from vehicles on the road.

The auxiliary plant comprises an air compressor and a vacuum pump with the necessary piping, &c., for starting the engine and priming the pumps. The vacuum pump is a 6in. by 4in. double-throw exhauster, which is driven separately by a 5 brake horse-power Petter engine. There are two 36in. sluice valves, having four faces of gun-metal and fitted with gearing for operation by means of hand wheels. We are informed that as a result of the official tests the guarantees of the makers were exceeded, both as regards the output of the plant and the fuel consumption.

External and internal views of the station are given in the accompanying engravings.



EXTERIOR VIEWS OF THE PUMPING STATION



INTERIOR OF THE PUMPING STATION

## JUNIOR INSTITUTION OF ENGINEERS.

IN his presidential address to the Junior Institution of Engineers, Dr. Alexander Russell mentioned first the general trend of invention and then discussed the encouragement of engineers and inventors. He expressed the belief that the teaching of a few practical subjects intensively and effectively was of far greater value to engineering students than an attempt to get them through a heavily laden curriculum. It was, he said, in the national interest that a certain proportion of the best boys from the public schools should be attracted to the engineering profession, for the material welfare of the country depended upon the prosperity of the engineering industries, on the excellence of systems of transport and communication, and on the efficiency of the great electric generating stations which were growing so rapidly all over the country. It might be doubted whether the present generation worked harder than the last; but, at any rate, it worked at a much higher speed, and all kinds of devices were used to accelerate its rate of working. Whether that movement was altogether for the ultimate benefit of the human race was a moot question, but that it existed, everyone who had had experience of modern business methods knew. The incentive was the increase of profits that came from doing an increased volume of work in a given time, by the aid of machinery. Speed and haste had two very different meanings, and if the quality of the work did not suffer by the higher rate at which it was done, then the increase was beneficial, especially when it increased the time of the worker for exercise and recreation. Amongst the devices for speeding up business, automatic telephony and printing telegraphy, or teletyping, would play a prominent part in the future. In concluding, Dr. Russell dealt with many of the latest advances in the use of electricity and electrical apparatus, including radio communication, and also referred to the present theories of the atom and other secrets of Nature which have not yet been divulged.

## TRAFFIC DELAY AND LEVEL CROSSINGS.

SOME little time ago a correspondent wrote to *The Times* complaining of the delays to motor car traffic caused by roads crossing the railway on the level. He said, quite truly, that the whole trouble would be entirely eradicated by the provision of overbridges, and added:—"If necessary a Bill should be introduced compelling the railway companies to provide, at their own expense, adequate over-bridges. In the long run it would be no great hardship to them, as they would be saved the expense of the upkeep of gates at level crossings, and the cost of labour to supervise them." Another correspondent replied on the following day and pointed out that such bridges needed approach roads which involved the purchase of property. That effectually disposed of the original proposal and no more has been heard of the matter. We would, however, revert to the subject in view of some recent police-court proceedings, when the driver of a motor omnibus was summoned for using a bridge over the Great Western Railway in defiance of a notice board limiting the axle loads. The railway company took proceedings because it was responsible for the repair and maintenance of the bridge.

## Railway Matters.

THE administration of the South African Railways proposes to lay down an installation of day colour light signals on a line in the Capetown suburban area.

WORK is to be started in April on the extension of the Szepingkai-Tsanan Railway, in China, towards Tsitsihar. The distance is about 140 miles, and the cost of the work is put at, say, £60,000.

THE Southern Railway is about to equip the area between London Bridge, Cannon-street, Holborn and Charing Cross with day colour light automatic signals, and to substitute power for manual signalling at some of the boxes.

THE grouping of the railways has led to the retirement, on the 31st ultimo, of Mr. J. A. Hookham, formerly the locomotive, carriage and wagon superintendent of the North Staffordshire and for the last two years the divisional mechanical engineer at Stoke-on-Trent.

A COMPANY with a capital of 3,004,000 kroner, which has been formed in Sweden for the purpose of constructing a railway from Katrineholm to Koeping, is asking for a State loan of 2,310,000 kroner towards the cost of the whole railway, which is estimated at 5,400,000 kroner.

PRESS reports state that a tire of the engine drawing an express from Manchester to Blackburn on the 7th inst. broke as the train was running through Sough Tunnel. There was no derailment, and the driver took his train on until he reached Spring Vale, the station on the Blackburn side of the tunnel.

RAPID headway is being made with the construction of a junction between the Tachira Railway (Venezuela) and the Cucutá Railway (Colombia). Only 15 kiloms. separate the two lines, and, this distance once bridged, an outlet will be afforded for the large coffee products of the Santander (Colombia) district, by way of Port Maracaibo (Venezuela).

THE alteration at the "Chatham" Station at Victoria, referred to in our annual article on the 9th inst., consisted of the removal of the siding between Nos. 3 and 4 platform roads and the provision of an additional platform on the space thus set at liberty. Nos. 2, 3, 4 and 5 platform lines have been shortened and this has allowed for a circulation area.

IN order to speed up work in connection with its programme of new rolling stock, the London, Midland and Scottish Railway has placed an order for two 50-ton overhead travelling cranes for its Horwich works. These will replace the existing 30-ton cranes, which have been in use for the past forty years and are unable to carry the larger modern engines.

TWO Tasmanian engineers, Messrs. C. L. Adams and R. F. Waller, have been chosen by the Spanish authorities to supervise the construction of 256 miles of railway over the rough mountainous country which separates Santander from Calatdyud. The link is being made for strategic reasons, and the line will cost £10,000,000. It will, it is stated, involve the driving of the longest tunnel in the world.

WE are officially informed that the directors of the London and North-Eastern Railway Company, at their meeting last Friday, accepted with much regret the resignation of Mr. W. T. Weeks, chief stores superintendent of the company, who has found it necessary to retire from the company's service in consequence of continued ill-health. Mr. Weeks was appointed as chief stores superintendent to the new company as from March 1st, 1923, and was formerly stores superintendent to the Great Northern Railway Company.

THE annual article on railways which appeared in our last issue was necessarily written before the year was ended, and the information therein given as to railway accidents was somewhat in anticipation. It may now definitely be stated that there were three accidents to passenger trains in which passengers lost their lives and that the total number of passengers killed was 23. Thus, in the number of casualties last year was the worst since 1915. The number of fatal accidents is the same as in eight other years of the present century; in four years there were only two; in two years only one and in two years there was no fatal accident. Of the accidents that occurred up to September 19th fifteen had been reported upon; of these there were nine collisions, four derailments and two buffer-stop collisions.

IN connection with its £14,000,000 scheme of new construction of rolling stock, &c., the London, Midland and Scottish Railway announces that orders have been placed for 235 third-class vestibule coaches with Cammell, Laird and Co., the Birmingham Railway Carriage and Wagon Company, the Leeds Forge Company, and the Metropolitan Carriage, Wagon and Finance Company. These vestibule coaches are to be of a new type, an interesting feature of the specification being the exclusive use of steel for the bodies and frames. In addition to the locomotive contracts already placed by the company, an order has just been secured by Nasmyth, Wilson and Co., Limited, for five 4–4–2 passenger tank engines of the existing Midland type. These engines are for service on the London, Tilbury and Southend section of the system.

IT is reported from Aracajú, Brazil, that the President of the State of Sergipe has approved a proposal for the construction of a number of railways. The principal line will leave the capital (Aracajú) and serve the municipalities of Socorro, Larangeiras, Riachuelo, Italaiana and Sao Paulo, extending to the boundary of the adjoining State of Bahia. The second line will leave the port of Crasto, and serve the municipalities of Santa Luzia, Estancia, Lagarto, Simao Diaz, reaching also the frontier of Bahia. A branch from Santa Luzia, or some other point yet to be selected, will be thrown out in order to serve the three smaller towns of Italaianinha, Campos and Araua. The State of Sergipe, the smallest in the Brazilian Union, is lacking in both railways and roads, while, being devoid of great rivers, its little inland navigation is available only for small craft. It is proposed, therefore, to connect a number of shallow channels and form a system of canals to be worked in connection with the proposed railways.

## Notes and Memoranda.

THE deposits of iron ore at Kromdraai, near Warmbaths, South Africa, are said to contain 66 per cent. of metallic iron.

SOME remarks made at a recent meeting of the Engineers' Society of Western Pennsylvania, by Mr. H. D. James, show that in times of emergency men are hoisted from American coal mines at a speed of between 5000ft. and 6000ft. per minute, but he advocated a speed not above 1000ft. per minute.

IT is reported that a German firm has secured patent rights for a process of making concrete vessels impervious to acids, by means of spraying liquid sulphur on to the surfaces of the vessel. It is claimed that such a vessel will contain concentrated hydrochloric acid for nine months without deterioration.

IN the case of a boiler explosion, just reported on officially, the failure was caused by the overheating of the fire-box crown, through shortness of water. The water-gauge fittings were in good order except that a ball valve in the water end was jammed on its seating by means of a splinter of glass, presumably the outcome of a previous gauge glass breaking.

A NOTE issued by the Railway Department of the Government of India, gives the following corrigendum to technical paper No. 235. Notes on the bridge rules of 1923. Page 16: Substitute the following in place of (*a*) and (*b*) in the note to paragraph 28: "The Railway Board are willing to consider recommendations for smaller impact factors than those prescribed in rules 26–28 in any particular case, such as that of a well balanced electric or steam locomotive, provided that proof is produced that the factors prescribed in rules 26–28 are excessive for the particular case in question."

THE Mines Branch, Canada, has found a new use for bentonite. A commercial enterprise desired to grind lump asphalt to a powder for use in waterproofing paper board. When ground alone, the fine particles adhered to one another, and this difficulty was not successfully overcome by adding clay or talc to the asphalt. Since bentonite was known to assist in forming water suspensions of enamels and to be capable of forming an emulsion with asphalt, it was applied to the above problem with results which showed that an exceedingly smooth, stable paste suitable for incorporating into felt, paper or other materials, could be produced. An addition of 20 per cent. of bentonite in the wet grinding of asphalt assists materially in the production of a fine, uniform product.

AN account of long distance wireless communication from the Chosi (Japan) wireless station by means of a Marconi M C 1 type 1½-kilowatt valve transmitter, was contained in a recent edition of the Japanese newspaper *Asahi Shimbun*. The officer in charge of the Chosi station, having communicated at night with the American steamer President Jefferson over a distance of 3500 miles, and with the President Wilson in daylight at a distance of 2000 miles, succeeded in communicating with San Francisco (K F S), a distance of 4500 miles. The two stations exchanged greetings, and the American station, in replying, used a 15-kilowatt arc transmitter. The M C 1 type of continuous wave valve transmitter was primarily designed for ship installations, as an addition to the spark transmitting apparatus, and was constructed to communicate between ships up to distances of 1500 miles.

ACCORDING to the American Bureau of Standards, nickel cannot be smith-welded, owing to the formation of a coating of nickel oxide, which cannot be fluxed and which prevents the adherence of the two surfaces to be welded. On the other hand, in conditions in which a reducing atmosphere may be maintained, the metal may be very satisfactorily welded, as by the use of the oxy-acetylene torch, the metallic arc-welding process, or by electrical resistance welding. It is by the latter method that nickel wire is welded to iron lead wire to form tips or points for spark plugs. Nickel tubing is welded by electrical resistance, and a speed of 69ft. per minute has been attained. Nickel may be soldered and brazed by the ordinary methods. It should be tinned before soldering, as is done with iron. Under suitable reducing conditions, nickel may be plastically welded to steel.

A VERY unusual type of explosion is referred to in a recent official report, which deals with the failure of a steam receiver at a Rotherham ironworks. The receiver was 7ft. in diameter by 20ft. long, and was worked at a pressure of about 150 lb. per square inch. One end was completely blown out, but fortunately no one was seriously hurt. It was found that not only were the dished ends a bad fit in the shell, but that the rivet holes were punched badly and that a pressure of 100 tons had been used with a hydraulic riveter in closing the rivets. In his remarks the engineer surveyor-in-chief points out that steel which has been injured by punching or crushed by excessive riveting pressure is liable to crack when subject to tensile stress, and in numerous riveted seams of other boilers cracks have been observed starting at the corners of the rivet holes at the facing surfaces which can hardly be accounted for except by injury to the metal surrounding the hole such as would be produced by excessive riveting pressure or by punching.

IT appears from a report of the Research Department, Woolwich, which deals with "gun wire," that cold-drawn wire is in a state of imperfect elasticity under tensile stress, ceasing to obey Hooke's law, and giving permanent set at comparatively low loads. The progress of elastic recovery is negligible at atmospheric temperature, the effect of one hour at 100 deg. Cent. being just detectable. Elasticity is restored by heating at 200 deg. Cent. for one hour or at higher temperatures for shorter times. On heating for one hour or more at above 220 deg. Cent. the elastic limit begins to fall. The restoration of elasticity is accompanied by increase of maximum load and Brinell hardness number, fall of elongation, increased resistance to torsion and decrease in the maximum angle of twist at fracture, but the treatment required to produce the maximum elastic limit does not necessarily produce the maximum effect on any of these properties. Rest at atmospheric temperature after low-temperature heat treatment causes no appreciable change in properties.

## Miscellanea.

A FACTORY which has just started work at St. John, New Brunswick, is said to be capable of turning out 2000 electric lamps daily.

THE steamboat piers at Folkestone Harbour are to be roofed in so that passengers can walk from the trains to the steamers under cover.

NEW buildings are to be put up at Birmingham University to house the department of oil mining. The head of the department is Professor Nash.

IT is proposed to construct a dry dock capable of taking vessels of from 2000 to 3000 tons, at Launceston, Tasmania, at a cost of from £50,000 to £70,000.

THE scheme for providing the Dearne Valley with an additional supply of water from the Sheffield Corporation works will involve the laying of seven miles of pipe line.

THE Damoodar River Bridge, near Telmucho, which forms an important link in the communications with the Jharia coalfields, India, and comprises eight spans of 151ft. each, was recently opened for traffic.

WORK has been started on some new shipping berths at the deep water quay on the northern face of Madras Harbour, and it is hoped that the draught provided will be sufficient for any steamers likely to call for many years.

A HALFPENNY token dated 1792, which was recently taken over a shop counter in Neyland, bears a portrait of John Wilkinson on the obverse and a blacksmith on the reverse. *The Ironmonger* says that the Wilkinson is evidently the ironmaster who established the first blast-furnace in Bilston about 1748.

THE Leith Dock Commission has received an intimation that the Government is prepared to offer 50 per cent. of the interest on money required for a period of fifteen years to finance the proposed scheme of dock extension at Leith. The scheme includes the erection of a breakwater about 2000 yards in length at a cost of £426,000, and the construction of dock works within the reclaimed area at a cost of £655,000.

DURING last year the Royal National Lifeboat Institution continued its programme of motor lifeboat construction which was begun at the end of the war, and new motor lifeboats were completed and sent to Portrush, Ireland; the Mumbles; Douglas, Isle of Man; Yarmouth, Isle of Wight; and Teesmouth. Another five are nearing completion and should be ready to go to the coast early this year. There are now 50 motor lifeboats in the Institution's Fleet of 221 lifeboats.

AFTER about two years of constructional work the first two units of the Isle Maligne hydro-electric plant, of the Quebec Development Company, are to be started this month. The sets are of 45,000 horse-power each, and work under a head of 110ft. Eight turbines are being installed, but the ultimate capacity of the plant is to be 540,000 horse-power, while, with a second station, that is to be built further downstream, the total output of the company will be 1,200,000 horse-power.

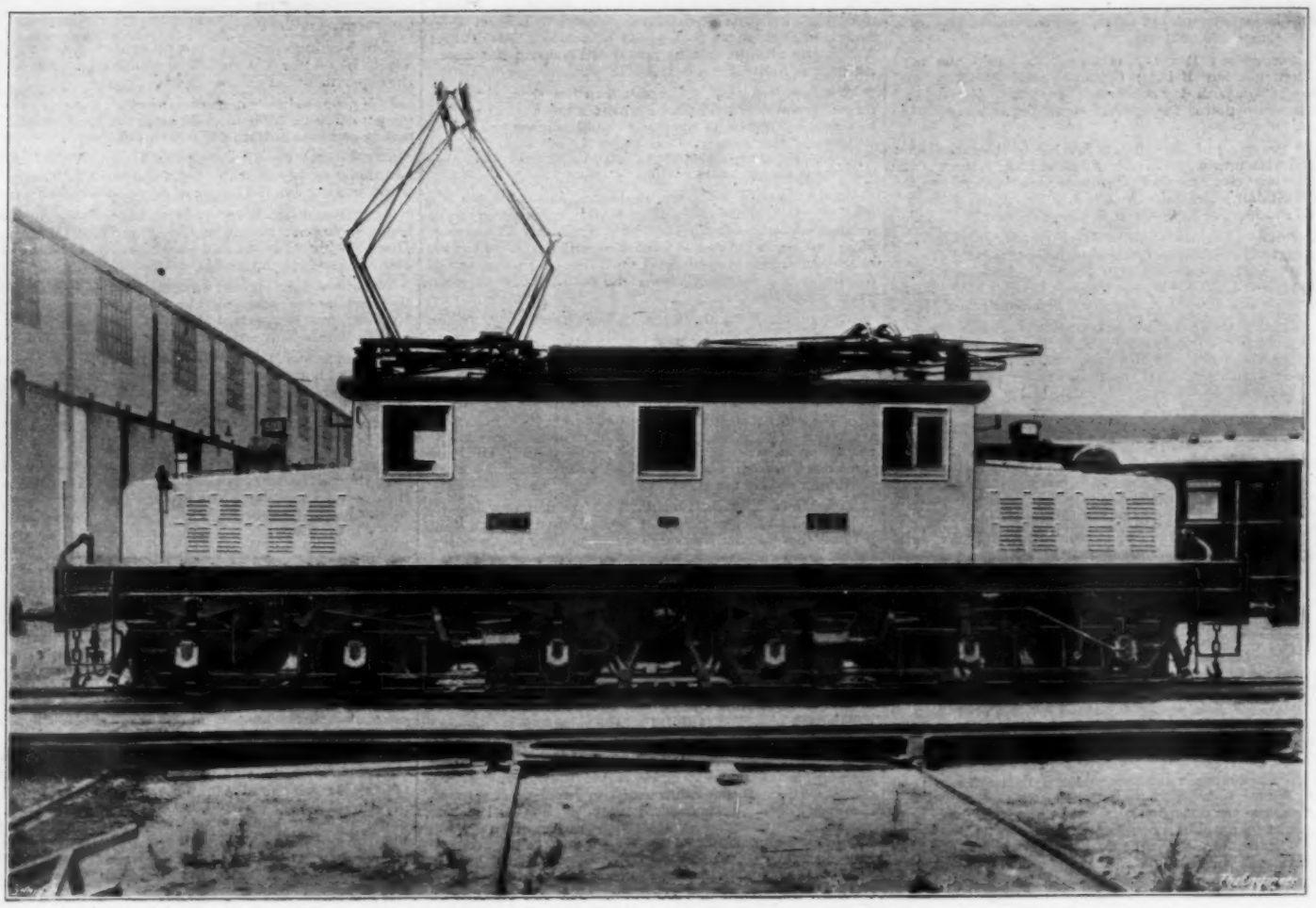
OWING to difficulty in obtaining sufficient supplies of cement at reasonable prices from abroad, the Government of the State of Rio Grande do Sul, Brazil, has given authority for the erection of a large cement factory, to be operated electrically, at Rio Grande. The construction, the cost of which is estimated at 10,000,000 milreis (£250,000), will be financed partly by the Federal Government, which contributes one half, and partly by a private company that has already been formed. The plans will follow closely those of two similar factories erected in Argentina and Uruguay, which are now giving satisfactory results. The machinery and plant will be purchased entirely abroad. Further particulars may be obtained from the British Vice-Consulate at Rio Grande do Sul, or the Ministry of Public Works, Rio Grande do Sul, Brazil.

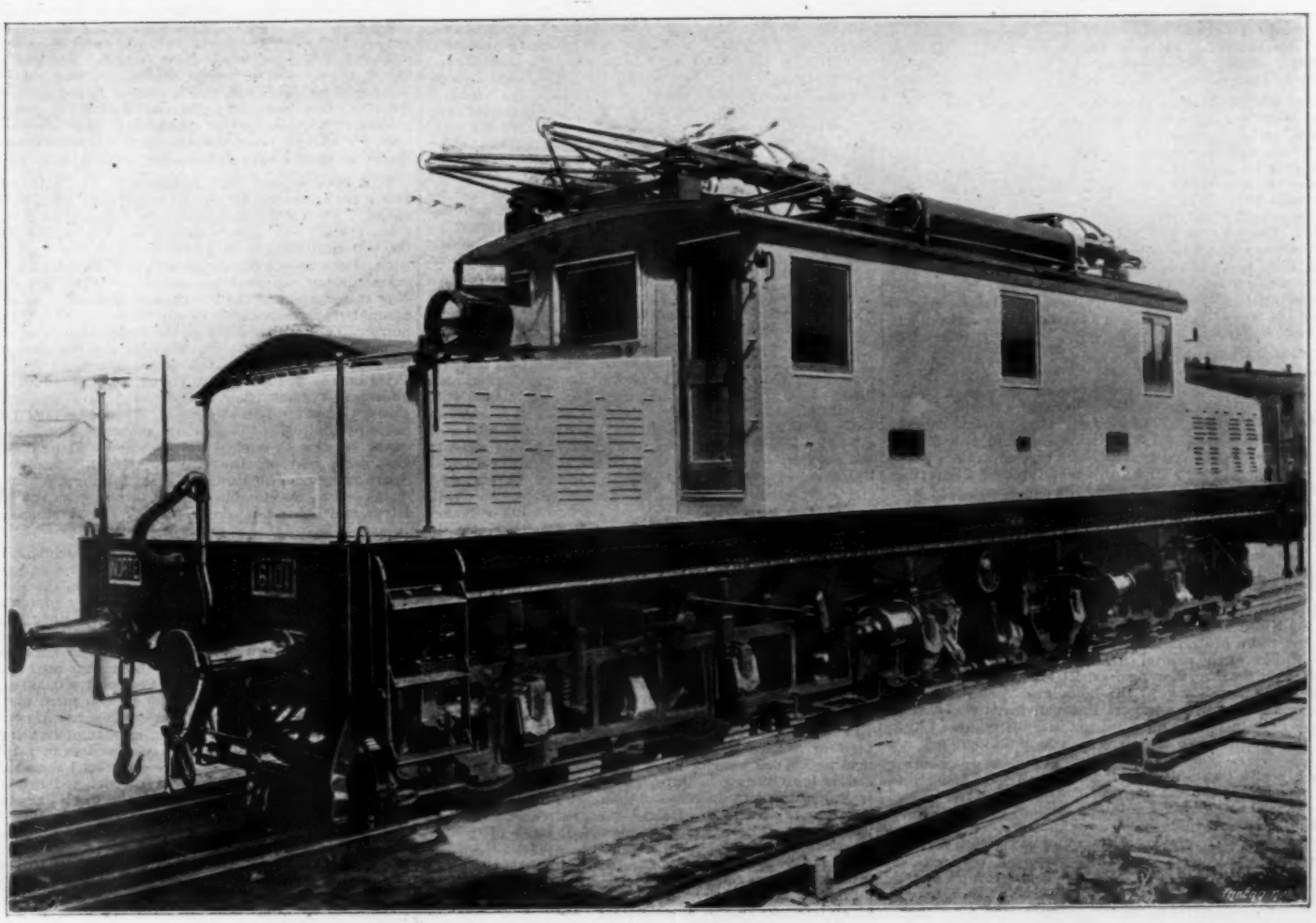
THE development and distribution of hydro-electric power in Canada was largely increased during the year just closed. The total installation now amounts to 3,569,275 horse-power, and developments for the production of 600,000 additional horse-power are now nearing completion. Investments of new capital in hydro-electric enterprises during the year amounted to 45,000,000 dollars. New installations in the Province of Quebec increased the amount of power available by approximately 175,000 horse-power. They were mainly at the Cedar Rapids of the St. Lawrence and on the St. Maurice and Quinze rivers. Nearing completion are the developments of Duke and Price on the Saguenay, the Hemming Falls plant of the Southern Canada Power Company, and the Ottawa Power Company dam at Bryson. Ontario added 132,000 horse-power during the year, the principal increases being made by the Provincial Hydro-electric Commission at Chippawa, and on the Nipigon, Trent, Muskoka and South rivers. The Hollinger Gold Mining Company has developed a considerable amount of power on the Abitibi River and other new developments are at Niagara and Kenora.

IT is announced from Toronto that the Shawinigan Water and Power Company, Limited, has broken ground for another power development at St. Narcisse on the Batiscan River, Quebec. The company's subsidiary undertaking, the North Shore Power Company, has already at that place a generating station which develops 1200 horse-power, with a possibility of being increased to 10,000 horse-power. The new power plant is expected to be completed by May, 1926, and the cost is estimated at about 1,500,000 dollars. The work will employ from 500 to 600 men, and will require the use of about 20,000 cubic yards of concrete. The work will entail the driving of a tunnel with a net diameter of 13ft. and nearly three-quarters of a mile in length, which will be lined with reinforced concrete. It will extend from the dam to be constructed just above Grande Chute on the Batiscan to Chute Des Cheminees about 3500ft. below, where the power house will be built. The tunnel will be driven under the existing plant, which will remain in operation during the constructional work. The dam will back the water for two miles to Chute Platte. The power from the plant will be connected with the Shawinigan company's transmission line to Quebec at a distance of six miles.

# 3000-VOLT D.C. ELECTRIC LOCOMOTIVE FOR THE NORTE RAILWAY, SPAIN

(*For description see page 84*)





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## Contents.


THE ENGINEER, January 16th, 1925. PAGE

A SEVEN-DAY JOURNAL .. 65
THE BRITISH STEAM RAILWAY LOCOMOTIVE FROM 1825 to 1924. No. III. (Illus.) .. 66
WATER SUPPLY IN 1924. No. I. .. 68
A NEW METHOD OF HIGH FREQUENCY RESISTANCE MEASUREMENT .. 69
THE FRICTION OF PISTONS AND PISTON RINGS. (Illus.) .. 70
THE MOTOR LINER AORANGI. No. III. (Illus.) .. 72
THREE-WIRE, DIRECT-CURRENT DISTRIBUTION NETWORKS. (Illus.) .. 75
LETTERS TO THE EDITOR—
Robert Stephenson .. 76
A History of Business .. 76
NEW PUMPING STATION IN THE FEN DISTRICT. (Illus.) .. 76
JUNIOR INSTITUTION OF ENGINEERS .. 76
TRAFFIC DELAY AND LEVEL CROSSINGS .. 76
RAILWAY MATTERS—NOTES AND MEMORANDA—MISCELLANEA .. 77
LEADING ARTICLES—
Dr. Russell's Address .. 79
Fuels and the Future .. 80
LITERATURE .. 80
OBITUARY—Sir W. E. Garstin—F. Cleeves—G. H. Baxter—H. H. Hellins—R. Wallwork—W. Lees .. 83
CENTENARY OF HENRI GIFFARD, 1825–1882 .. 83
INTERNATIONAL CRITICAL TABLES .. 83
REPLACING THE LOCK GATES OF THE EXETER SHIP CANAL .. 83
FEDERATED MALAY STATES RAILWAYS .. 83
ELECTRIC LOCOMOTIVES FOR THE NORTE RAILWAY OF SPAIN. (Illus.) .. 84
15-TON SIDE-TIPPING WAGONS. (Illus.) .. 85
TERMS OF PAYMENT IN CANADA .. 85
SIXTY YEARS AGO .. 85
SHIPPING LOCOMOTIVES. (Illus.) .. 86
SOUTH AFRICAN ENGINEERING NOTES .. 86
CALENDARS, DIARIES, &c. .. 86
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 87
Lancashire .. 87
Sheffield .. 88
North of England .. 88
Scotland .. 89
Wales and Adjoining Counties .. 89
CURRENT PRICES FOR METALS AND FUELS .. 90
FRENCH ENGINEERING NOTES .. 91
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 91
FORTHCOMING ENGAGEMENTS .. 92

TWO-PAGE SUPPLEMENT—QUADRUPLE-SCREW MOTOR LINER AORANGI: MAIN ENGINES.



# THE ENGINEER.

*JANUARY* 16, 1925.


### Dr. Russell's Address.

THE presidential address which Dr. Alexander Russell delivered before the Junior Institution of Engineers on Wednesday, January 7th, was of more than ordinary interest to the younger members, for besides reviewing past scientific and engineering progress, the President paid attention to the future. It may well be asked, in view of the progress of recent years, what the future holds in store, yet few engineers or even professors seem to give the question much thought. Practical men no doubt find enough to occupy their time in grappling with the problems of their every-day work, but students and the younger members of the profession should not fail to realise that before many years are past important changes may be witnessed. As Dr. Russell remarked at the close of his address, it is rash to prophesy the kind of prime mover or the kind of illuminant that will be the most popular thirty years hence. There are, he said, infinite possibilities in the future, and it would be foolish to suppose that science and its applications are approaching finality. These are facts which students and young engineers should not on any account overlook, and it is also well that they should remember that, although great things have been accomplished, we are all still very much in the dark as to why certain things happen under certain conditions and that a better understanding of these matters might prove distinctly beneficial from the point of view of future progress. Quite recently, for instance, Mr. Marconi delivered an address before the Royal Society of Arts on "Radio Communication," in which he described his latest short-wave experiments, which are said to have demonstrated that with the aid of very low-power transmitting stations it will be possible to maintain commercial wireless services by day and night between England and the most distant parts of the globe. But Mr. Marconi did not attempt to suggest any scientific explanation of these results, owing, of course, to his inability to do so. Is there anyone, we should like to ask, who can satisfactorily explain the extraordinary results that have been obtained by amateurs who, when using an extremely small amount of power, have succeeded in communicating with New Zealand and Australia? Wireless theory is still imperfectly understood, and on this score alone we agree with Dr. Russell's statement that team work and organised research are excellent and are indeed absolutely essential in many branches of science.

Many theories have been evolved to explain why it is that electric waves can reach great distances, and as to how they can bend round the globe so as to be received with ease even at the Antipodes. The idea that is pretty generally accepted is that the waves are reflected by what is known as the Heaviside layer, which is supposed to be a conducting layer of rarefied and ionised gases, constituting a kind of shell concentric with the surface of the earth. The layer is regarded as a curved ceiling above the earth and is held to be capable of reflecting electric waves which are enclosed between two concentric surfaces from which they cannot escape. This theory, as someone remarked at a meeting of the Radio Society, is utilised to explain away all sorts of phenomena which experts do not understand, notwithstanding the fact that it has never been definitely proved that the Heaviside layer actually exists. In wireless work alone there is plenty of scope for research, and no student who is thinking of joining this branch of electrical industry need have any fear of running short of fascinating problems. The engineering student of to-day, and especially the electrical student, has a far greater outlet for his activities than the man of the past. Added to electrical engineering of a few years ago, when young engineers were concerned mainly with dynamos, motors and lamps, are other branches which offer great possibilities to the man with good abilities. As far as we can see it does not matter very much what branch of electrical engineering a young engineer decides to embark upon, provided that he is fitted for the work which it involves. There is plenty to be done in all directions. The technical colleges are turning out some exceptionally able men, who seem to experience little difficulty in keeping pace with the times. Students or engineers only at the opening of their careers frequently produce before the engineering societies' papers which, we venture to suggest, are sometimes just a little beyond the comprehension of many of the older members. When these highly trained men take up serious work in the engineering profession it is reasonable to suppose that changes will be brought about and a good deal of the present conservatism will be swept aside. But it does not, of course, follow, as Dr. Russell clearly realises, that brilliant students always make the most brilliant engineers. The genius is not necessarily the man who passes all the stiff examinations. Indeed the reverse is often the case, and in this connection Dr. Russell's remarks are well worth quoting. "There is no asset of greater value to the country," he says, "than a genius, and a heavy responsibility rests on every teacher to encourage the first tentative efforts of superior ability. Many young men of high ability in one special line never come to the front owing to their inability to get over the ring fence of examinations, which now hedges round every profession."

The exacting requirements of present-day engineering, with its difficult examinations and other ordeals, are apt to cause some of the younger men to lose heart and to give up all hope of ever becoming proficient engineers. Yet if the careers of some of the most successful in the profession are studied it will be seen how very great obstacles—far greater, in fact, than those which face the average student—have been overcome. Dr. Russell took as an example Professor Michael Pupin, who is one of the most eminent electricians, and the inventor of the well-known Pupin coils, which, in connection with long-distance telephony, have saved many millions of pounds to almost every civilised nation of the world. Pupin, the son of Serbian peasants, was born sixty-five years ago in a village in Serbia so small that it is not marked on any map. At the age of fifteen he landed in New York with five cents in his pocket, which his appetite compelled him to spend at once. Yet he eventually became, as we have already said, one of the most eminent electricians, and introduced a device which proved an immense boon to mankind. Many other similar examples might, of course, be cited, but the case of Pupin should serve to encourage the disheartened student and to cause him to face the future more fearlessly. Dr. Russell has more than once laid stress on the well-known fact that failure to pass examinations is not necessarily an indication of sure failure in after life. His long experience as a teacher of electrical engineering places him in a position to give sound advice on the training which young men should receive, and although his address was not by any means confined to educational matters, one of its main objects obviously was to help the student. In our opinion, all who contemplate becoming engineers should first of all decide beyond all doubt whether they are really interested in engineering and whether they can stand plenty of hard work, and if both these

questions can be answered in the affirmative, then there is a very good chance of a reasonable measure of success.

#### Fuels and the Future.

IT is difficult to feel deeply stirred by the possible embarrassment of the human race two thousand years hence. We have enough difficulties in the living present to occupy our attention fully, and we are no more capable of thinking into the fourtieth century than the ancient Chinese were of thinking into ours. When, therefore, we learn from Dr. Low's presidential address to the American Society of Mechanical Engineers that all the present sources of heat supply will be used up in two thousand years or so our withers remain unwrung. We live in a century of marvellous happenings. What science may bring forth on any morrow we do not know, and however great the wonder may be, our surprise lasts for but a few days. If during the present year some inventor demonstrates a means of reducing the consumption of British thermal units per horse-power to one-half of their present amount, we shall praise him for a week and then set about discovering means of robbing him of his credit and proving that his work has been anticipated by some prior investigator. Hence, moving as we do from discovery to discovery, whenever the Cassandras of industry bid us beware of the future we turn a blind eye to their portents and a deaf ear to their prophecies. The future will look after itself just as our own days are doing. No one can tell when the time may come that our pit shafts will be allowed to tumble in, our oil wells to spout ineffectually into the air, and our great rivers and cataracts to pour their streams unharnessed to the sea, because we have found means of generating more power than we need by controlling the clash of atoms.

Whilst time continues to provide us with new marvels we shall remain incapable of projecting our thoughts into periods more remote than a decade or two from our own, and we shall continue to be moved in our search for greater economy by the immediate needs of the present rather than by the problematic needs of our descendants near or remote. It has always been so. We cannot believe that when Newcomen quartered the coke consumption of Savery that he gave a thought to the possible exhaustion of the world's supply of coal, and we remained convinced that when Watt halved the coal consumption of Newcomen, he was stirred rather by the bonus he received on every pound of coke saved than by any desire to conserve our fuel supply. It is in vain, therefore, that Dr. Low tells us in his delightful address that the eleven million tons of anthracite which still exist in the United States will be consumed in about one hundred years, and that if the present rate of increase of consumption continues at eighteen million tons yearly all the bituminous coal and lignite in America will have been converted to ashes in five hundred years. It is in vain that he recalls the words of one of his predecessors in the chair which he occupies that "the end of humanity would occur when the surviving habitants of this cooling planet will be engaged in exterminating one another in a fight for the few remaining heat units." It is in vain that he tells us "it is not too early to have that possible fight in mind and plan to delay it as much as possible if it cannot be averted. Two thousand years is not such a long time in the history of a race that has been on earth a million years or more, and if old Tut Ankh Amen had run his kingdom by steam instead of with slaves, and the world generally had followed the practice, we should be in that predicament now." We are unmoved by such appeals, and we shall continue to seek for economy in coal consumption for the same reason that inspired Newcomen, Watt and their long train of successors, namely, the hope of present gain. It is that impelling force which is driving us daily towards more economical consumption of fuel. The efficiency of heat conversion in the steam turbine and the internal combustion engine is approaching a point beyond which further progress can hardly be attained, but in both much still remains to be done by the more skilful employment of the energy in the fuel. Thus we find advantage being taken of bleeding and reheating in steam turbines of higher superheat, and an increasing use of steam boilers for the generation of steam from the waste gases of internal combustion engines. The time is not so far distant when we shall be able to develop one horse-power hour for the consumption of less than seven pounds of steam, which we may reasonably expect to be provided in a modern boiler plant for about three-quarters of a pound of fair coal, or, in Dr. Low's words, "for about 0.7 of a pound of 12,000 B.Th.U. coal."

With such figures no longer remote we may be satisfied with the progress that engineers are making. But whilst a small number of actual engines are developing power for low consumption, vast numbers are spendthrifts of our coal supplies. Moreover, we squander daily great quantities of useful heat, in the form of waste gases from furnaces, and whilst we would do nothing to check the continued search for economy in great power stations, we cannot but feel that even more might be done for the economisation of fuel supply by increased attention to the small and extravagant steam plants, and by the encouragement of those who have waste heat at disposal to make profitable use of it. The development of super-power stations is held by many to be the solution of the problem of fuel conservation, but we ourselves hesitate to accept that opinion without reservation, and we note with some satisfaction that there is a tendency to regard it with less confidence than there was a few years ago. The records of the Electricity Commission have stimulated power station engineers, and, as the annual returns show, admirable efficiencies are now realised by even quite small stations. Moreover, still greater consideration is being given to the employment of waste heat for the supply of electricity to local areas, and it would be a deplorable thing if, in the encouragement of super-power stations, anything was done to check possible developments in that direction.

## Literature.

*The Corrosion of Metals.* By ULICK R. EVANS, M.A. (Cantab.). London: Edward Arnold and Co. 1924. Price 14s. net.

THIS little book grows in interest on closer perusal, though at first sight its obvious faults strike the reader most forcibly. For a book of its size it is overloaded with literature references, which are incomplete as a history of the subject, and irksome to the classes of readers appealed to. These readers are enumerated as (1) practical engineers and works chemists, (2) investigators engaged on research into corrosion and allied subjects, (3) students of engineering, metallurgy and inorganic chemistry. As a general impression one may say that the book is somewhat beyond classes (1) and (3), and too elementary and lacking in detail for class (2). The adoption of Nernst's and Planck's treatment of absolute potentials instead of the old Thomson-Helmholz rules for potential difference is likely to give trouble to classes (1) and (3), and the author seems to forget that the basis of all the formulæ is the same, viz., the total work of the voltaic combination in question. Similarly the reference to transition elements instead of the "old" Group VIII. of the "old" periodic system is somewhat academic, as probably most engineers know the whole of that subject by hearsay only.

The historical survey defines the object of the book more precisely than the title. It enumerates the theories of corrosion as: (1) The "acid" theory, (2) the hydrogen peroxide theory, (3) the electrochemical theory, (4) the newer electrochemical theory. Apart from (1) and (2) being incommensurable as conceptions with (3) and (4), it so happens that they are both subordinate to the electrochemical theory. The newer electrochemical theory is the author's main theme, and it refers to action by dissolved oxygen as a depolariser as distinct from that of gaseous oxygen. The main point, according to this theory, is that wet rust enhances oxidation by screening the underlying layer of metal from *direct* access to oxygen. Some ionisation of dissolved oxygen would, hence, appear to be accountable for the difference, though the reviewer has found no statement to that effect in the book.

After the historical part follows a chapter on direct oxidation, inter-granular penetration, &c. &c. Then comes a chapter on "The Passage Between the Metallic and Ionic Conditions," which might have been omitted without detriment to the book, as those who want the information given do not understand it, and those who do understand it do not want it. The reviewer wonders how an engineer will reconcile the statement on page 29: "The potential of platinum saturated under one atmosphere—(with hydrogen, REVIEWER)—immersed in acid of normal hydrion concentration is by *definition* 0.00 volts," with the experimental proof that it is 0.8 volts against a *non-polarising* pole (pp. 24 and 25). Why not be confidential with the reader and tell him that the figure has no importance whatsoever for couples in aqueous solutions, as it subtracts out?

The chapter on anodic corrosion by means of externally applied electric current or, in the language of ordinary mortals, electro-metallurgy is, as treated, also unnecessary; but one wonders why the chapter on corrosion involving the production of hydrogen gas has been so scantily treated, as some of the most promising quantitative work has been done on these lines. The illustration Fig. 9 is somewhat amusing, with "electron stream" and "galvanometer indicating current" used on the same circuit.

Corrosion in the presence of dissolved oxygen is evidently the author's main subject, and it is treated with some detail, enabling the reader to get an idea of the author's views, at least in Part II., Corrosion due to unequal distribution of Oxygen. Here we have three fundamental experiments with illustrations. These bring us back to the time of the contact theory of galvanic action and have the added charm of antiquity. The "Key Experiment" is a repetition of old experiments to determine the contact voltage between oxygen and metals. Two pieces of the same metal are immersed in an electrolyte, separated by a diaphragm. Air is bubbled through one compartment, but not through the other. The aerated metal becomes the positive pole of an outside circuit, and a measurable current is obtained. To repeat that experiment to-day seems hardly necessary. Then comes experiment 2, which consists in putting a strip of zinc in a solution so as to protrude partly into the air, and the author finds that chemical corrosion takes place just below the surface of the electrolyte, an also well-known result, which used to be called treble contact effect. The third experiment is a gravity stratification repetition of the "Key Experiment" (pp. 73–75). On consideration anybody can see that the effect in experiment 2 is not comparable with those of 1 and 3, as the two poles are in dead metallic short circuit, and that hence no potential difference in the ordinary sense exists between one end of the zinc strip and the other to explain a current passing through the electrolyte of a magnitude comparable with the effect, which may be surprisingly great. The seat of the E.M.F. is undoubtedly in the electrolyte in this case, probably a bombardment by potassium and chlorine ions with partial depolarisation by dissolved oxygen. This is a most interesting class of phenomenon, and the author giving it prominence is deserving of great credit, especially as his drop experiments further on show that a continuous layer of electrolyte is unnecessary. The further investigations described in this line are also very readable.

The rest of the book does not advance any claim to originality, and the examples given are well known to investigators on the subject. To engineers and others the practical part should be of great interest. For the purpose of a review it is not possible to follow all the subjects, which are so numerous as to amount to almost an enumeration. Some details of non-corrosive alloys and prevention of corrosion are given, also in a highly condensed form. On the whole the book is interesting, but requires amplification to be really useful to the practical man.

*Electrical Design of Overhead Power Transmission Lines.* By W. T. TAYLOR and R. E. NEALE. London: Chapman and Hall, Limited. Price 21s. net.

ALTHOUGH transmission lines are not employed on a large scale in this country, and there are often considerable obstacles in the way of their use, it is pretty certain that in the future many more high-pressure overhead lines will be erected. In America, where this form of transmission is used on an extensive scale, there is no lack of literature on the mechanical and electrical problems involved, but, comparatively speaking, in this country transmission line literature is scarce. A fair amount has, however, been written on the subject within recent times, and this new volume by Messrs. Taylor and Neale forms a useful addition to the books and articles that have been produced.

It is particularly applicable to the conditions which prevail in Great Britain, for it has special reference to pressures up to 60,000 volts and distances up to 100 miles. The design of "super transmission lines," hundreds of miles in length and operating at 200,000 volts or higher pressures, involves special problems which do not arise when lower voltages and shorter distances are concerned. Relatively, few engineers, as the authors themselves explain, are ever called upon to design transmission lines exceeding 100 miles in length or operating at pressures higher than 60,000 volts, but any electrical engineer may be required to design a transmission line for shorter distances.

As the title of the book implies, only the electrical side of the subject is dealt with. The headings of the nine chapters are "Transmission Systems and Circuit Relations," "Standard Data for Conductor Materials," "General Formulæ for Area and Weight of Conductors," "Power Factor and Power Factor Correction," "Alternative Bases for Line Design," "Impedance and Power Loss Calculations and Charts," "Weight and Cost of Conductors," "Design of Transmission Lines for Minimum Cost," and "Transmission Systems Compared." The last chapter throws a good deal of light upon the relative merits of the different systems which are at present applicable to practical work. Tables show the relative weights of conductors required by various transmission systems for equal percentage ohmic voltage drop and the relative total weights of conductors required by various transmission systems using conductors of economic section.

Although the calculations involved in the design of alternating current lines are naturally more complicated than those associated with direct-current lines, the authors have confined themselves to the simplest mathematics, and care has been taken to state the units of measurements. Vector diagrams are naturally used to a fair extent, especially in the chapter on transmission systems and circuit relations, but these should not give the average practical electrical engineer very much trouble.

On the whole, the authors have dealt with the subject on very simple and straightforward lines. Special attention is paid to power factor, and power factor correction problems, which are naturally very closely related to economical transmission. Here, again, the authors provide some useful tables showing the reactance factor, ratio of idle to active component, and the phase angle corresponding to power factors ranging from unity to .5, and the power factor and reactance factor for various phase angles. In a third table the ratios of idle to active component for various power factors are given. There are many other tables in the book, and much useful data which should prove of considerable assistance to those who have to grapple with transmission problems.

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*Mechanics of Textile Machinery.* By WILLIAM A. HANTON, M.Sc. Tech. London: Longmans, Green and Co. 12s. 6d. net.

WE know of no branch of mechanical engineering of which the theoretical point of view has been so neglected by writers as that of textile machinery, and Mr. Hanton, who is lecturer in textile engineering in the College of Technology, Manchester, has conferred a boon upon students of this subject by compiling this instructive volume. The book is divided into five parts. In Part I., after an introductory chapter on principles of elementary mechanics, a more advanced study is made of the parts of mechanics needed in studying the working of machinery. Part II. deals with spinning machinery; Part III. with preparatory machinery: Part IV. with the power loom; and Part V. deals briefly with the driving and power testing of textile machines. There is also an appendix containing a series of questions with answers. The reader is expected to have some knowledge of elementary mechanics and of the working of textile machinery, and in order that the matter shall be intelligible to those having only a limited knowledge of mathematics, graphic methods are used very extensively to assist the explanations. The wide range and diverse character of the numerous motions involved in textile machinery are not sufficiently understood by engineers. Take, for instance, the winding motions, which form such important features of the ring and mule spinning frames. In the mule the roving—a relatively thick and very slightly twisted strand of cotton fibres laid parallel in the direction of the length of the strand—is drawn out by rollers, twisted, and after a certain length of yarn has been produced these operations are suspended until the yarn so produced is wound on the spindle to form the cop. In the ring spinning frame the operations of drawing out the roving, twisting it and winding it on to the bobbin or tube carried by the spindle are performed simultaneously, and the mechanism by which these operations are brought about requires to be made with the utmost accuracy by mass production methods. In these delicate spinning operations the effects of the position of the ring rail, change of spindle speed, the weight of the traveller, and the diameter of the ring have all to be taken into consideration. There is no positive regulation of the winding speed. The tension on the yarn during winding depends on the resistance offered by the traveller to movement round the ring, and this tension automatically increases until it exerts sufficient force on the traveller to keep it moving. The author describes by diagrams and simple mathematics the forces which come into play, such as changes of spindle speeds, the weight of the traveller and the effect of the diameter of the ring. Some idea of the delicacy of the various parts referred to and the absence of friction can be gathered from the very small amount of energy required to operate them.

There are chapters dealing with the power loom and its various essential motions, such as the slay movement, and the shedding and picking motions are adequately dealt with. Sections on driving textile machinery and testing the power consumed are also included, and sketches of simple forms of dynamometers are given.

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*The Economics of Iron and Steel.* By H. J. SKELTON. Second edition, revised and enlarged. London: Stevens and Sons, Limited, and H. J. Skelton and Co., Limited. 1924. Price 20s. net.

THE first edition of Mr. Skelton's book appeared as long ago as 1891. Much water has flowed under the bridges in the intervening years, and that the old edition no longer met the circumstances of to-day was obvious to all who sought information in its pages. Twenty-three years ago puddled iron still held a fairly important position; to-day it is quite in the shade and amounts to no more, as Mr. Skelton himself tells us, than 10 per cent. of the British output represented in tons of pig iron. Steel has all but monopolised the field. Hence Mr. Skelton has found it necessary to revise the book very largely, and, of course, he has had to extend it considerably. In the first edition he commented severely on the wasteful elaboration in the number of rolled sections. Since its appearance the British Engineering Standards Association was created, and the offence is not so rank as it was and daily grows less. It is estimated by competent steel makers that the work of that Association, in which Mr. Skelton himself has taken an important part, has reduced the cost of production of rolled sections by something like one million pounds per annum. Such landmarks as these show how necessary it was that a new edition of an invaluable work of reference should be prepared.

Owing to its age there may be some who are not familiar with "Skelton," and we shall therefore give a rough outline of the contents of the new edition. It begins with an introductory chapter, in which the author gives a brief review of the economics of the iron and steel industry; it, and the preface, are indeed the most "economical" in the book until we come nearly to the end, where we find a long chapter on commerce in iron and steel. The last passage from the introductory chapter is worth quoting. "The strongly marked individuality characteristic of Englishmen is a weakness whenever they are compelled to find an external market for their products. Sections of the nation act as if their activities could be isolated in water-tight compartments. The occupations which a statesman of England has described as 'sheltered' trades, the railway, shipping, dock and port interests, and transport workers generally, are not always well informed as to the possible effects of the incidence of their charges for services on the costs of the producers. The position of Great Britain in the markets of the world is being maintained by the good quality of her products, faithful performance of contracts, and the honesty of her bankers, merchants and traders." The title which Mr. Skelton has selected for his volume might lead one to suppose that it is concerned with the development of the ideas expressed in this passage. As a matter of fact, there is very little reference to such things.

The second chapter is entitled "Ironstone and Iron Ores," and for the greater part may be regarded as an extended dictionary of the terms employed in connection with ores. It contains many useful analyses of home and foreign ores and ironstones. In the next chapter "Cast Iron and the Blast-furnace" are treated in a similar way, and in the two succeeding chapters "Warrants and the Testing of Cast Iron" are described. From cast iron we pass on to wrought iron and to steel and thence to steel products of all kinds, and to heat treatment and testing. Then comes the chapter on "Commerce" already alluded to, followed by a "Nomenclature of Iron and Steel" and "Some Short Notes on Gauges Corrosion," some tabular matter and finally a "Terminology of Some Special Terms used in the Metallurgy of Iron and Steel."

From this survey it will be gathered that the volume—a stout one—is one to put on the shelf with books of reference and not with text-books. It is, no doubt, primarily intended for those who are engaged in the commerce and use of iron and steel rather than for steel producers and metallurgists, and by such and even by a wider public it should be given a warm welcome.

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## SHORT NOTICES.

*Regulations for the Electrical Equipment of Buildings.* London: E. and F. N. Spon, Limited. Price 1s. 6d. net.—The eighth edition of this little book on "Regulations for the Electrical Equipment of Buildings" was issued some months ago, but the present book is a cloth-bound copy and costs sixpence more than the original copy with paper covers. As we explained in a Seven-day Journal note appearing in our issue of August 1st, owing to the differences in opinion of the various interested parties the compilation of the new rules presented great difficulty, and it was not until Mr. Ll. B. Atkinson adopted the plan of settling the various clauses on the basis of volts that the rules began to assume their present form. The problem of earthing seems to have given rise to much thought and discussion, and although certain rules have been laid down, it is open to any responsible person to put forward alternative schemes to meet special requirements. Subject to certain specified conditions, a fuse may now be placed in an intermediate adapter designed for insertion in a wall socket.

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*Small Craft.* By R. Munro Smith. London: The Association of Engineering and Shipbuilding Draughtsmen. 1924. 12s. 6d.—The absence of any extensive literature concerning the smaller craft which help to make up our mercantile marine, is, no doubt, largely to be accounted for by the fact that these vessels are generally built in our less imposing shipyards, and themselves do not catch the eye so readily when afloat. The design and building of many of these little ships, such as trawlers, ocean-going tugs, and so forth, involves much skill, as the compromises which must be made between conflicting requirements are very difficult. It is this aspect of the subject, rather than detail constructional features, with which Mr. Smith deals, and he makes it interesting and instructive. Practically every class of craft up to, say, 150ft. long, except sailing vessels, is included, a separate chapter being given to each type. There is even a brief chapter on lightships, while the relative merits of oil and steam engines are compared at the end of the book.

*Ball and Roller Bearings.* By A. W. Macaulay. London: Sir Isaac Pitman and Sons. 1924. 12s. 6d. net.—The fact that the late Mr. A. W. Macaulay, the author, was for some time technical manager in the service of the Skefko Ball Bearing Company is in itself almost sufficient introduction to this handbook. It should not be thought, however, that there is any undue bias in the subject matter of the book; all the well-known makes of ball bearings are treated impartially. The first eighty pages or so are devoted to theoretical considerations, and then there follow some 300 pages of essentially practical matter showing, with the aid of some excellent line drawings, how ball bearings can be applied to a very large variety of mechanical elements. The work is completed by a number of tables giving the capacities, &c., of ball bearings and a list of suppliers.

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*The Rôle of the State in the Provision of Railways.* By H. M. Jagtiani. London: P. S. King. 1924. Price 8s. 6d.—In this volume the author places before the reader a good deal of familiar matter about the course of development of railways in England, much far less familiar information of the same order about Prussian railways and a fair outline of the Indian scheme. He, apparently, reaches the conclusion that Government should keep a firm hand on railways but should not own them. It should, however, "insist that a surplus of the profits, above a certain reasonable return, should be utilised for the public benefit." Surely if the "reasonable return" is specified the railway managers would see that there was no excess. They would certainly reduce their rates or increase their expenditure. The volume appears with a warm tribute from Sir William Acworth, which should be sufficient to commend it to all railway economists.

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*Switchgear for Electric Power Control.* By E. Basil Wedmore and Henry Trencham. London: Humphrey Milford. Price 25s.—This is not a complete treatise on switchgear, but a record of the author's experience whilst engaged in the switchgear business. Users and designers of switchgear should find the volume useful. It deals more particularly with heavy duty switchgear, such as that used in large power stations, and not with motor starters and rheostats. The author pays considerable attention to protection, which, of course, has now become a very important branch of the subject. The book is well up to date and quite in conformity with present-day requirements.

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*The Greater Problems of Industry.* By Alexander Ramsay. Birmingham: The *Journal* Office. 1924. Price 3s. 6d.—Mr. Ramsay chats pleasantly enough about industrial problems, but he has nothing whatever new to say about them, and such suggestions as he has to make have been made scores of times before. His book may be useful to those who know nothing about industrial problems.

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## BOOKS RECEIVED.

*Flame Safety Lamps.* By J. W. Paul, L. C. Ilsley and E. J. Gleim. Washington: Government Printing Office.

*Les Lignites.* By E. Marcotte. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 20f.

*The Motor Ship Reference Book for 1925.* London: Temple Press, Limited, 7–15, Rosebery-avenue, E.C. 1. Price 5s. net.

*The People's Year Book, 1925.* The Co-operative Wholesale Society, Limited, 1, Balloon-street, Manchester. Price 3s. net.

*Size and Character of Grains of Non-metallic Mineral Fillers.* By W. M. Weigel. Washington: Government Printing Office.

*"Mechanical World" Year Book, 1925.* London: Emmott and Co., Limited, 20, Bedford-street, W.C. 2. Price 1s. 6d. net.

*Théorie de la Relativite.* By T. Greenwood. Paris: Gauthier-Villars et Cie., 55, Qrai des Grands-Augustins (6e). Price 10f. net.

*The South American Handbook, 1925.* London: South American Publications, Limited, Atlantic House, Moorgate, E.C. 2. Price 7s. 6d. net.

*Wireless Working Hints for Beginners.* By A. Williams. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 1s. 6d. net.

*Concrete Making Machinery.* By W. N. Twelvetrees. London: Scott, Greenwood and Son, 8, Broadway, Ludgate, E.C. 4. Price 8s. 6d. net.

*Communications Scientifiques et Faits Industriels de l'Année (1922–1923).* By Edmond Marcotte. Paris: Payot, 106, Boulevard St. Germain.

*The "Practical Engineer" Mechanical Pocket Book and Diary, 1925.* Edited by Ernest G. Beck. London: Humphrey Milford, Amen House, Warwick-square, E.C. 2. Price 3s. 6d. net.

*The "Practical Engineer" Electrical Pocket Book and Diary, 1925.* Edited by Conrad Arnold. London: Humphrey Milford, Amen House, Warwick-square, E.C. 2. Price 3s. 6d. net.

*Report on the Financial, Commercial and Economic Conditions of the Argentine Republic.* By H. O. Chalkley. London: H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

*Annales des Ponts et Chaussées.* Fasc. 5. Tome II. (1) *Partie Technique, Septembre–Octobre*; and (2) *Partie Administrative, Septembre–Octobre*, 1924. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin.

*Report on the Economic, Financial and Commercial Conditions of the Republic of Panama and the Canal Zone.* By R. Keith Jopson. London: H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

*The Deterioration of Structures in Sea Water.* Fourth (Interim) Report of the Committee of the Institution of Civil Engineers. London: H.M. Stationery Office, Imperial House, Kingsway, W.C. 2. Price 3s. 6d. net.

## Obituary.

### SIR WILLIAM E. GARSTIN.

WITH deep regret we have to record the death of Sir William Edmund Garstin, which took place on January 8th. Sir William was born in India in January, 1849, was educated at Cheltenham College, and then studied engineering at King's College, London, after which he entered the Public Works Department of India in 1872, and was employed on irrigation work. His name is best known in this country in connection with that class of engineering; but it was in Egypt and not in India that most of his work was done.

In 1883 Sir Colin Scott Moncrieff had been appointed Inspector-General of Irrigation in Egypt, and with him were at first two irrigation officers from India, Colonel Justin Ross and Sir William Willcocks, who were followed a year later by two others, Sir Hanbury Brown and Mr. E. W. P. Foster, a small band of five, who undertook the heavy task of reorganising the system of irrigation in Egypt, which had fallen into chaos during the maladministration of the preceding decade. In 1885, when Sir Colin Scott Moncrieff became Under Secretary of State in the Public Works Ministry, Colonel Justin Ross took over the duties of Inspector-General of Irrigation, and Mr. W. E. Garstin, as he then was, was called from India to take charge of the irrigation of the eastern half of the Delta, in which position he continued for seven years, effecting great improvements and becoming well known to the landowners of that part of Egypt. The extremely high flood of 1887 and the exceptionally low one of 1888 tried severely a young service which was striving to improve the existing system, and at the same time to meet the demands of the agriculturists which increased with every improvement which was introduced.

In 1892 Colonel Justin Ross retired and was succeeded as Inspector-General of the Irrigation Service by Mr. Garstin, who, on Sir Colin Scott Moncrieff's retirement, a month or two later, became Under-Secretary of State in the Ministry of Public Works. This change brought into his work much besides irrigation, though that was still the most important and the most extensive of the services under him. At that period the finances of Egypt had become more flourishing than they had been in the previous decade, the worst faults of the old irrigation had been remedied, and the time was ripe for new projects. The need for an insured supply of water in the early summer months for the better cultivation of cotton had led to the critical examination of several schemes which had been proposed, and the Delta Barrage had by then been repaired and strengthened sufficiently for it to operate usefully.

The most favourable site on the Nile for a dam and reservoir having been found to be at the First Cataract near Assuan, the next step was to lay the project before an international technical commission, which was appointed in 1895, and on which Sir Benjamin Baker was the British member. Many difficulties, both technical and financial, had to be surmounted, and it was not until 1898 that Sir William Garstin had the satisfaction of seeing the contract signed for the construction of a dam at Assuan, though it was to be 7 m. less in height than had been originally proposed. Unfortunately the construction of the dam at this point involved the partial submergence of the island and temples of Philæ, and round this "vandalism" much opposition centred. But when once it had been demonstrated that no other site equally suitable could be found, Sir William Garstin provided as generously and as effectively as possible for the safeguarding of these ancient structures. The foundations of the temples were carefully examined, and wherever they were not carried on rock extensive underpinning to a point below the permanent saturation level was carried out, with the result that no ancient building in the country is more stable to-day than the temple of Philæ.

While the dam at Assuan was being built great changes had been taking place in the region of the Upper Nile. The advance upon Dongola was commenced in 1896, and with the taking of Omdurman in 1899 the Sudan came under Anglo-Egyptian control. The new regime provided the opportunity for the study of the region of the river, the conditions determining its floods, the rainfall on which they depended, and many other matters of fundamental importance, which for years had been inaccessible to study. At the earliest practicable moment Sir William Garstin visited the Upper Nile and arranged for the clearing of the sudd-blocks, those masses of drifted and growing vegetation which had closed for years considerable reaches of the Bahr el Jebel, the branch of the Nile which brings the surplus water of the equatorial lakes to the Sudan. In the course of this and several subsequent reconnaissance journeys Sir William developed his knowledge of the hydrography of the Upper Nile, and came to the conclusion that the future line of development should be to look to the White Nile for the main addition to Egypt's supply and to the surplus water of the Blue Nile flood for the needs of the Sudan. The great Makwar Dam on the Blue Nile, now on the point of completion, is the reasoned outcome of this policy.

At that time accurate measurements of the volume discharged by the various branches of the Nile were altogether wanting, but a beginning was made in 1903, and the undertaking has been steadily developed as means have been available. The last publication of the Physical Department of Egypt shows that some 300 measured discharges of the Nile were taken in 1919, thus providing much reliable material for the preparation of hydraulic projects, such as was wholly wanting five and twenty years ago.

SIR WILLIAM EDMUND GARSTIN

By 1902 the Assuan Dam had been completed, and the barrages at Assiut and Zifta were ready for use. Their value to Egypt was at once demonstrated in the low Nile flood of that year, when the money value of the crops which were saved to the landowners of Middle Egypt and the Fayum, by making use of the Assiut barrage, was estimated as almost to equal the cost of that work.

During these years also a great deal of work had been done in remodelling the canals and drains in Middle Egypt, this being rendered necessary in conjunction with the Assuan reservoir and the barrage at Assiût for giving perennial irrigation to Middle Egypt. With the completion of these works Egypt was safeguarded against the occurrence of the famines which had in former times followed exceptionally low floods, and the area of cultivatable land which could not be adequately irrigated in years when the flood was markedly below the average was very greatly reduced. The province of Kena in Upper Egypt had, however, benefited less than most other parts of Egypt from the new irrigation works, so, in 1905, the construction of another barrage was begun at Esna in order to assist flood irrigation in that province and to enable the basin lands to the north of it to obtain water sufficient for their needs even in a year of bad flood.

By this time the Sudan Irrigation Service had commenced its work of studying the hydrographical conditions of the Upper Nile and of preparing schemes for the further utilisation of its waters. This work, too, came under Sir William Garstin's direction and supervision.

Successful as the Assuan Reservior had proved itself to be, its capacity fell short of what was requisite to meet the full requirements of Egypt, since it had not been carried up to the full height of the original design. Before raising it, however, Sir William Garstin had a complete survey of all possible sites between Assuan and Khartoum carried out, so that it was with full information that he and the Consulting Engineer to the Egyptian Government, Sir Benjamin Baker, went into the question of providing additional storage. Their examination showed that the site at Assuan was far more favourable than any of the others higher up the river, and consequently it was decided to proceed with work on the Assuan Dam in order to make it 7 m. higher. This deepening involved a further submergence of the valley margins up-stream of the dam, and the destruction of such records of early human habitation as might still exist there. On Sir William's recommendation, however, the Egyptian Government set aside a substantial sum for a thorough archæological examination of the area which would be thus submerged, and the work produced a wealth of information of great scientific and historical value. Unfortunately, only the earlier volumes descriptive of this important piece of work have as yet been published.

Sir William Garstin retired from the Egyptian service in 1908, after twenty-three years' arduous work, during which he had seen irrigation in Egypt emerge from chaos and play a principal part in the economic recovery of the country. At first every step forward brought large returns, but as efficiency increased and the margin of possible improvement became smaller, advance was only possible by close attention to details, by scientific thoroughness, and by unremitting care. His task has been worthily carried on by those who worked with him and remained after him to direct the most important of Egypt's public services. Let us hope that in the future Egypt may still be able to command the services of men as skilled, as able, and as disinterested in working for her welfare as Sir William Garstin and his colleagues have been, or her economic prosperity may seriously diminish.

As chief officer of the Ministry of Public Works irrigation was only one of the services for which Sir William Garstin was responsible. Public buildings throughout the country, the engineering works connected with the city of Cairo, the Department of Antiquities and other services fell within the control of the Ministry of Public Works. His solicitude for the ancient monuments which were imperilled by the Assuan reservoir has been mentioned. He was instrumental in bringing about the erection of the Archæological Museum at Cairo, in order that its unique collections might be safely housed. For many years he was an active and sympathetic member of the Archæological Committee before which questions relating to the antiquities of Egypt and their preservation were discussed. With questions and problems concerning the railways of Egypt and the Sudan, the ports of Alexandria and Port Sudan, he was closely connected, though these lay outside his own Ministry.

On leaving Egypt he was appointed British Government director of the Suez Canal Company, and on several occasions revisited Egypt and the Sudan in an advisory capacity in connection with many engineering works there in progress.

During the war, early in which his only son was killed, he engaged in work with the St. John's Ambulance and Red Cross Society with his customary energy, and his experience as an administrator was invaluable in the vast field into which the operations of those organisations developed between 1914 and 1918.

A man of wide and far-seeing outlook, quick in grasping the essential details of large and complicated schemes, clear and precise in his decisions, Sir William only needed the opportunity to show himself to be an administrator of exceptional ability, and that opportunity Egypt gave him. He was possessed of a charming personality, and while in that country endeared himself, in a remarkable manner, not only to his European colleagues, but also to the Egyptians themselves from the highest official to the humblest fellah. For the services he rendered in Egypt he

was created K.C.M.G. in 1897 and G.C.M.G. in 1902, and, in addition, received the Grand Cordon Medjidie and the Grand Cordon Osmanie, while for his war work he was made G.B.E. in 1918.

### FREDERICK CLEEVES.

A PIONEER in the commercial development of the West Wales anthracite coal trade has passed away in the person of Mr. Frederick Cleeves, who died on the 10th inst., at Penmaenmawr, at the age of eighty-two years. Mr. Cleeves was, with his son Mr. Charles E. Cleeves, very actively interested in the industry until about ten years ago, when he retired. A Londoner by birth, he became early in life secretary of the Rounwood Colliery, at Rotherham, and as the owners of that undertaking later obtained an interest in the Gwaun-cae-Gurwen Collieries in South Wales, Mr. Cleeves was sent to that district, and became secretary of the undertaking, which very largely developed as the result of the energy and foresight he displayed. In course of time his interests in the trade expanded substantially, and he was joined by his sons, John, Edward and Charles, who together gave special attention to the development of the continental trade. Mr. Cleeves was also largely interested in other undertakings, including the Cross Hands, Tirydail and Llandebie collieries, and in a company known as the Cleeves Western Valleys Anthracite Collieries, Limited, which was formed in 1914. About a year ago this company disposed of its interests to the Amalgamated Anthracite Collieries, Limited, and Mr. Cleeves and his sons retired.

### GEORGE HANDYSIDE BAXTER.

WE regret to have to announce the death, at the age of seventy-four, of Mr. George Handyside Baxter, who was formerly mechanical engineer to the Clyde Navigation Trust.

Mr. Baxter was born in Dundee and served his apprenticeship with Messrs. Gourlay Brothers at that port. From there he went to the Barrow Shipbuilding and Engineering Company, as chief draughtsman, and remained with the company for a number of years. On returning to Leith he joined the staff of Messrs. Ramage and Ferguson, with whom he was engaged for some years. Later he was made manager of the engineering department of Barclay, Curle and Co., Limited, Whiteinch, Glasgow.

In 1892 he was appointed first mechanical engineer to the Clyde Navigation Trustees, which position he held until 1921. Among the works carried out under his supervision were the transference of the mechanical workshops from Dalmuir to Renfrew, and the electrical equipment of Rothesay Dock Power Station, Clydebank, with its special plant, which was amongst the first of its kind in the United Kingdom, and included electric cranes, coal hoists, and capstans. Many of the Clyde Navigation Trustees' dredgers and hopper barges were built to his specification.

### HENRY HERBERT HELLINS.

THE death is announced of Mr. Henry Herbert Hellins. Mr. Hellins, who was born at Exeter in 1859, was a pupil of James Simpson and Co., of Pimlico, subsequently becoming in turn assistant to Mr. J. M. Martin, of Exeter, and chief assistant to Mr. George Chatterton, of Westminster. He acted as resident engineer for the Rhondda Valley outfall sewer, and thereafter, for thirteen years, for the main drainage of Dublin. From 1907 to 1917 he was engaged in private practice as a consulting engineer at Exeter, and later in Westminster.

Mr. Hellins entered the Institution of Civil Engineers as a student in 1880, was elected an associate member in 1885, and was transferred to full membership in 1896.

### ROUGHSEDGE WALLWORK.

WE put on record with regret the death of Mr. Roughsedge Walwork, chairman of Henry Wallwork and Co., Ltd, of Manchester, which occurred on Wednesday last, 14th inst., at his home, Manor House, Woodley, Cheshire, at the age of seventy-two. Mr. Wallwork was the nephew of the founder of this old-established business and was largely responsible for the progress that it has made during his chairmanship. Although he had not taken any active part in the business affairs during the last few years, owing to failing health, Mr. Roughsedge Wallwork was formerly a man of very active habits and of an inventive turn of mind, and was responsible for many inventions. He was elected a member of the Institution of Mechanical Engineers in 1893 and was also a member of the Iron and Steel Institute.

### WILLIAM LEES.

MR. WILLIAM LEES, whose death occurred unexpectedly on the 7th inst., at the age of fifty-five, was the grandson of the founder of the firm of T. R. Lees, engineers, Hollinwood, near Oldham. Mr. Lees had not been enjoying good health for some time, but was engaged in business as chairman and managing director of the firm up to the day prior to his death. He was an "all-round" mechanical engineer and was a member of the Institution of Mechanical Engineers and the Manchester Association of Engineers. The business is being continued by his two brothers, Walter and Ralph.

## Centenary of Henri Giffard, 1825-1882.

ON January 8th occurred the centenary of the birth of Henri Giffard, whose invention of the injector placed in the hands of locomotive engineers a simple and effective apparatus which, during the last sixty to seventy years, has been fitted to hundreds of thousands of boilers.

Giffard was born in Paris and as a boy attended the College Bourbon. At that time the earliest of French railways, that from Paris to Saint Germains, was being constructed, and it is said that Giffard would sometimes run away from school to watch the locomotives at work. However that may be, his bent was undoubtedly towards mechanics, and when at the age of seventeen he entered the shops of the Saint Germains Railway he found his true vocation. But even locomotives could not find scope for all his activities. His work with small light steam engines led him to the idea of propelling a balloon by steam. In 1851 he published his "Application de la Vapeur a la Navigation Aerienne," and the following year he constructed the first of all navigable airships. This craft was about 140ft. long, 40ft. in diameter, and contained 88,000 cubic feet. A net covered the long spindle-shaped gas bag, and from it was suspended a horizontal spar 66ft. long. At one end of the spar was a triangular sail, which acted as a rudder. The car was hung about 20ft. below the spar. The engine and boiler, weighing about 350 lb. and developing 3 to 5 horse-power, drove an 11ft. propeller at 110 revolutions per minute, and with this airship Giffard attained a speed of about 5 miles an hour. Three years later he made a somewhat larger one, 230ft. long, 33ft. diameter, containing 113,000 cubic feet. With his companion, Yon, he was making an ascent when the net slipped and the envelope burst. Giffard and his fellow voyager were fortunate in escaping with but slight injuries. After this plans were drawn up for an immense airship, 1970ft. long, containing over 7,000,000 cubic feet, but construction was never proceeded with.

It was after these pioneering experiments and while still engaged in locomotive engineering that he was led to the invention of the ejector. His patent was taken out in 1858. Received at first with incredulity, the principle on which it works not being generally understood, practice soon demonstrated its importance, and it speedily brought about a revolution in the mode of supplying locomotive and other boilers with water. In England its manufacture was taken up by Mr. C. P. Stewart, of Sharp, Stewart and Co., of Manchester, while another English engineer who made improvements in it was John Robinson. It was Robinson's assistant, John Barber, who, on account of his frequent visits to locomotive shops, became known as "Ejector Jack." There are papers on the ejector by Robinson in the "Proceedings" of the Institution of Mechanical Engineers for 1860 and 1866.

It was the fortune which Giffard received from his invention that enabled him to turn again to aeronautics, and in later years he made considerable stir by the giant captive balloons he constructed for the Paris Exhibition of 1867 and 1878. The former of these cost £30,000, while the latter raised no fewer than forty persons. Towards the end of his life Giffard became blind, and when he died in April, 1882, he was only fifty-seven years of age. He had received many high honours in connection with his most useful invention, and at his death he left a large part of his fortune to the French Government for the furtherance of science.

## International Tables.

AT the meeting of the International Union of Pure and Applied Chemistry held in London in 1919, the American delegates submitted a proposal for the international compilation of critically prepared tables of the physical properties of chemical substances and technological materials. The proposal was approved by the Union, and the American National Research Council at Washington has since assumed the financial and editorial responsibility for the undertaking. A Board of Trustees has undertaken to raise the sum of 200,000 dollars, or such part thereof as may be necessary. The editorial responsibility is invested in a board of editors, the editor-in-chief being Dr. E. W. Washburn, formerly Professor of Physical Chemistry at the University of Illinois. To insure the international character of the tables, corresponding editors have been appointed in the principal countries of the world.

The work of critically examining the data and of compiling the various tables is being carried out by well-known chemists, physicists, engineers, &c., some three hundred in number, who have been chosen for this purpose in the various countries of the world, largely on the basis of recommendations from the corresponding editors and their advisory committees. These experts are not being expected to assume the responsibility of searching the literature, a task which is being carried out in the main by the editorial staff at Washington, but rather to assemble, to examine critically and to select the best value for each constant, indicating at the same time the probable uncertainty.

Each portion of the tables will be published over the name of the co-operating expert who has assumed responsibility for the selection, reliability and accuracy of the data in question. The size of each assignment has been restricted so that the work may be carried out within a reasonable time and without becoming too great a burden for any individual—or co-operating group of individuals—to bear. The main language employed in the tables will be English, but the introduction, table of contents, definitions, general explanatory text, and a very complete index will be in English, French, German and Italian.

The tables will contain all available information of value concerning the physical properties and numerical characteristics of :—(*a*) Pure substances ; (*b*) mixtures of definite composition ; (*c*) the more important classes of industrial materials ; (*d*) many natural materials and products ; and (*e*) selected data for certain bodies or systems, such as the earth and its main physical subdivisions, the solar and stellar systems, and certain biological organisms, including man. Publications of the world in many languages have been searched for data, and much unpublished information has been collected.

For pure chemical substances the data will be assembled in tables of properties, but a certain amount of latitude and duplication will be permitted in some instances, and tables of materials will be employed where they prove to be more convenient. In some cases no definite value of a constant can be put down, but only upper and lower limits. In other cases a graph may be the best means of indicating the variation of the particular property in question.

The tables will be issued in a series of volumes comprising a total of about 2500 pages—10in. by 7in.—publication extending over about a year and a half. The progress made has been such that the first volume is now in the Press and may be expected during the early months of 1925. The published price of the tables will be from 60 to 75 dollars for the set, but the trustees are reserving the privilege of purchasing from the publishers at the rate of 35 dollars per set whatever number of sets may be required to fill all advance subscriptions received by the National Research Council of America up to a definite fixed date, probably April 1st or May 1st, 1925, after which date the privilege will lapse, and subsequent sales will be handled exclusively by the publishers at the higher rate.

The Advisory Committee for the British Empire—excluding British North America—consists of Dr. G. W. C. Kaye, corresponding editor ; Sir Robert Robertson, F.R.S., Dr. W. Rosenhain, F.R.S., Professor A. W. Porter, F.R.S., Dr. T. E. Stanton, F.R.S., Mr. J. E. Sears (jur.), Mr. A. C. G. Egerton, and Mr. W. F. Higgins as secretary. Dr. Rosenhain is also acting as special editor for metals and alloys. It is requested that any correspondence with reference to the tables should be addressed to Dr. Kaye, the National Physical Laboratory, Teddington, Middlesex.

## REPLACING THE LOCK GATES OF THE EXETER SHIP CANAL.

HAVING done duty for some four hundred years the Turf lock gates at the seaward end of the Exeter Ship Canal are shortly to be removed and replaced with more modern structures, under the supervision of Mr. J. Lovell, consulting engineer of Plymouth. The order for the renewal of the gates has been given to Messrs. Willoughby, also of Plymouth. The old gates are built of greenheart and oak, with iron fasteners, and each contains three sluices or "paddles," which are worked by hand, and there is a foot gangway from one side of the canal to the other. The lock is some 30ft. wide and 122ft. long and the lift wall is 7ft 6in. high. The old gates have been repaired on several occasions, but their present state of dilapidation now renders their removal an urgent necessity.

The new gates are to be constructed at Messrs. Willoughby's works during the winter, and it is hoped to have them in situation and the work completed by April. To carry out the renewal the canal will have to be closed for about a month. A cofferdam is to be built seawards and the headgates, which were repaired some years ago, are to be fastened in such a manner that the lock chamber will be kept dry during the actual renewal operations.

As this will be the first occasion for hundreds of years that the bottom of the ancient basin is exposed to the eye, it is thought by antiquarians that some interesting and valuable relics may be discovered. The Exeter Ship Canal is held to be the oldest canal in the United Kingdom, and it is proposed that when the Turf lock gates are removed they shall be preserved in the museum.

## FEDERATED MALAY STATES RAILWAYS.

IN a speech introducing the Supply Bill to the Federal Council on November 25th, the Chief Secretary to the Federated Malay States Government outlined the railway programme for the coming year. He stated that economic considerations demanded the expenditure of a considerable sum of money on the extension of the Eastern Branch of the railway through Pahang and Kelantan. An expenditure of 3 million dollars for work from the northern (Kelantan) end and of a million dollars from the southern (Pahang) end was asked for, and was recommended. With the approval of these allocations, the Pahang section should be completed during this year, without further cost, and on an estimated additional expenditure of 4 million dollars in 1926 and 2,800,000 dollars in 1927, the Kelantan section should be completed in the latter year.

Apart from railway construction in Pahang and Kelantan the work of the construction branch is to be confined to the completion of schemes already in hand. Special services on the open-line account amount to 867,000 dollars, and that figure has been arrived at after the most careful scrutiny of the department's requirements.

During the first half of the current year, the railway receipts showed a 13 per cent. increase over the corresponding figures for 1922, owing largely to the operation of the revised goods rates introduced on January 10th, 1924. A general reduction in passenger fares came into operation on July 1st, 1924.

# Electric Locomotives for the Norte Railway of Spain.

AN important electrification scheme is being carried out on the "Pajores" gradient of the Norte Railway of Spain. The line, which connects the North sea coast at Gigion and the coal mines on the northern slope of the Cobertoria Mountains with the inland cities, is at present very congested, and its maximum capacity has been reached. It is about 40 miles long, and is composed of light 5ft. 6in. gauge track, with very many curves and a 2 per cent. gradient. The tunnels, which form fully 50 per cent. of the total length of the line, are very wet, and many of them are over a mile long. Wet and slimy rails and gases from the locomotives have made the existing steam system very difficult to operate.

By the introduction of electric traction, however, very considerable improvements will be brought about. The capacity of the line will be increased, the dangers to which the engine drivers are exposed will be removed, and it is expected that there will be a substantial reduction in the working expenses, for the electricity is to be generated by means of water power, and regeneration will be employed on the down gradients. When the electrification scheme has been completed, it is intended to haul a trailing load of 300 tons, with a single locomotive, and 600 tons with two locomotives, at opposite ends of the train, the weight of the trains being governed by the maximum draw-bar pull, *i.e.*, 30,000 lb. of the draft gear on the cars.

Six 3000-volt direct-current regenerative locomotives, equipped with air brake apparatus for the locomotive and vacuum brake equipment for the train brakes, have been built by the Westinghouse Electric International Company for operation on this line. The mechanical parts were designed at the Baldwin Locomotive Works. The actual constructional work was carried out in Spain, and the engines were assembled by La Sociedad Espanola De Construccion Naval. The locomotives—which are shown on page 78 and in Fig. 1—are of the six-axle type, with two six-wheel swivel trucks. Each axle is driven through a single helical gear by an axle-mounted motor rated at 270 horse-power for one hour. All the motors are wound for a pressure of 1500 volts, so that two machines in series can be connected directly across the line. The cab in each case is of the steeple type, with a large hood at each end. These hoods contain the major part of the auxiliary apparatus, such as the air compressor exhausters, blowers, motor generator set, storage battery and their automatic control apparatus.

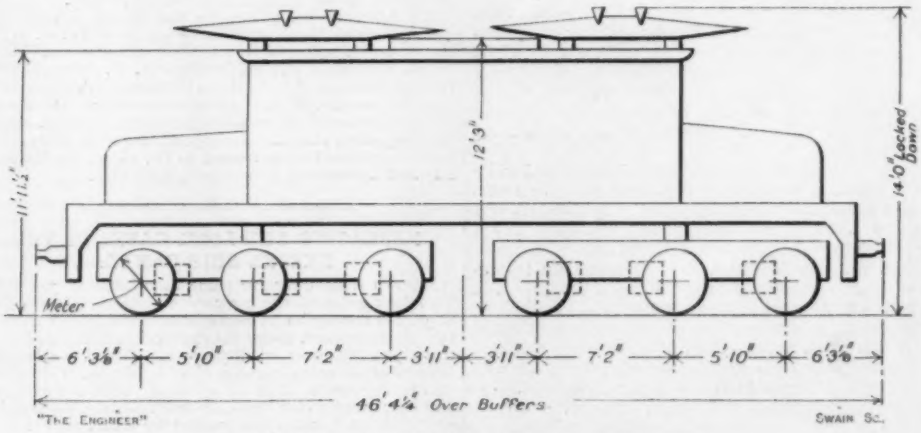



FIG. 1—PROFILE OF SIX-AXLE ELECTRIC LOCOMOTIVE

The control equipment, which is similar to that supplied by the Westinghouse Company to the Paulista and Chilean State Railways, has been designed with a view to obtaining simplicity and flexible control.

All the switches, such as the line resistance and motor combination switches that have to deal with heavy currents, are of the electro-pneumatic unit type, as shown in Figs. 2 and 3. The circuits for the motor combinations and for regeneration are controlled by electro-pneumatic cam-operated switches, as shown in Fig. 4, while the regenerative regulating and stabilising resistance switches are of the electro-pneumatic unit type without magnetic blow-out coils. The master controller is shown in Fig. 5. Three speed combinations are arranged for, viz., series, series-parallel, and parallel, corresponding to one-third, two-thirds and full speed, the series or one-third speed motor combination being obtained by connecting all the six motors in series. For this combination eleven resistance notches and one running notch are provided. The series parallel or two-thirds speed motor combination is obtained by connecting two sets of three motors in series, and in this case eleven resistance notches and one running notch are also used. The parallel or full-speed motor combination is secured by connecting in parallel three sets of two motors in series. Eleven resistance notches and one running notch are provided for this arrangement, but normally only nine of the resistance notches will be used. Changes from one combination to another will be made by means of a motor combination handle on the master controller, arranged so that the locomotive may be accelerated through the three speed combinations in series or in any one of the three combinations as desired. This arrangement makes the locomotive extremely flexible, a matter of great importance where trains have to be handled on heavy gradients and where the adhesion is low and the rolling stock is light, as is the case on most European railways.

On account of the very light track construction, limiting the axle loading to a very low figure, it has been necessary to limit the total locomotive weight to 92.5 tons. Every effort has therefore been made to cut down weight wherever possible. In the control equipment a large saving in weight has been made possible by blowing air through the grid resistance. Regenerative braking with all the three motor combinations is arranged for, the system employed corresponding with that used on the Westinghouse locomotives on the Chicago, Wilwaukee and St. Paul Railway, and the Paulista Railway and Chilean State Railways. For each motor combination, thirteen running notches are provided, and during regeneration a wide speed range is secured, which meets all train and gradient conditions. The regenerated current is controlled in a manner similar to that used for the motoring current, except that after the driver has chosen the speed and motor combination, and has placed the motor combination and accelerating handles in their correct positions, the speed and braking effort are controlled by the regenerative handle.

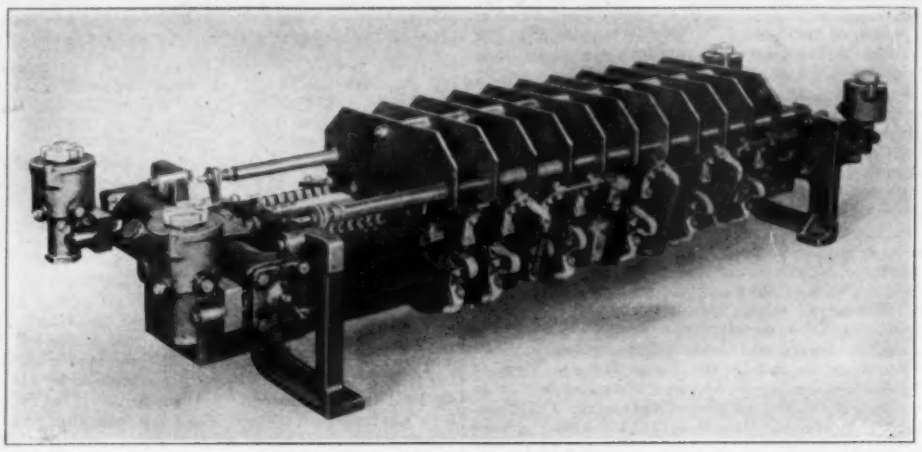
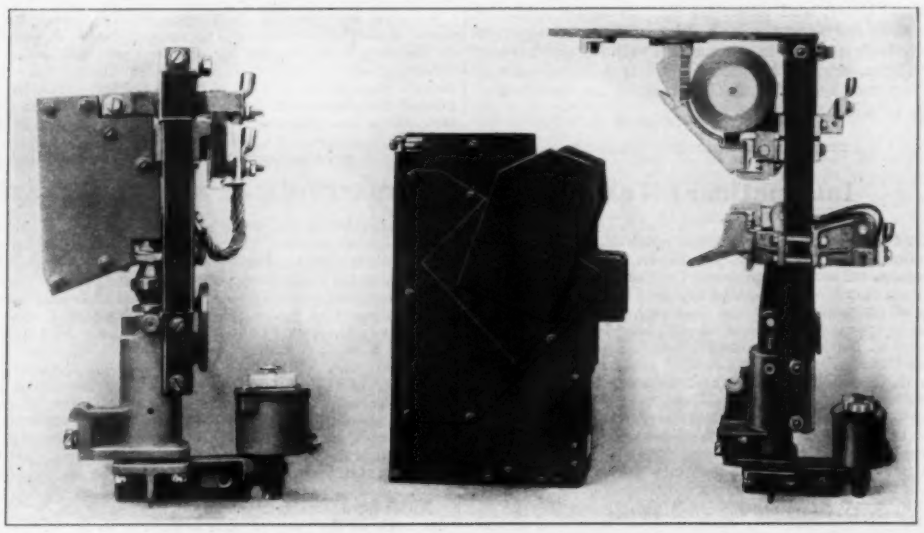


FIG. 4—ELECTRO-PNEUMATIC CAM-OPERATED SWITCHES



FIGS. 2 AND 3—ELECTRO-PNEUMATIC HIGH VOLTAGE UNIT SWITCHES

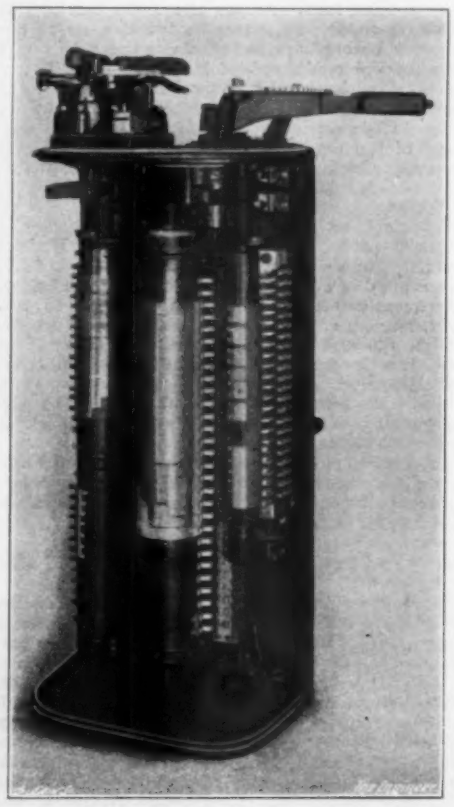


FIG. 5—MASTER CONTROLLER

The air and vacuum brake equipment consists of standard air brakes for the locomotive and vacuum brakes for the train. The locomotive brakes are controlled by an independent brake valve and by the vacuum brake valve. The latter handles the locomotive air brakes, together with the vacuum train brakes in the same manner in which the automatic brake valve is employed on the standard locomotive.

Compressed air for the air brakes and for control purposes is supplied by a motor-driven air compressor, and the vacuum for the train brakes by two motor-driven rotary exhausters. The auxiliary equipment consists of a 3000-volt motor generator set, which supplies the low-voltage power for control purposes, the lights, air compressors and

exhausters, and charges a floating storage battery, which serves as a reserve for operating an air compressor or exhauster in the event of the line power failing. The following tables, which, together with the above information, has been supplied to us by Mr. W. R. Taliaferro, engineer to the railway equipment of the Westinghouse Electric and Manufacturing Company, give the main dimensions of the locomotives and other leading particulars, the rating being based on the American Institute of Electrical Engineers' rules.

TABLE I.—*General Data on Westinghouse-Baldwin-Naval Locomotives.*

| | |
|---|---|
| Service | Goods and passenger |
| Gauge | 5ft. 6in. |
| Wheel arrangement | 0-6-0 + 0-6-0 |
| Rigid wheel base | 13ft. |
| Total wheel base | 33ft. 10in. |
| Length over buffers | 40ft. 4½in. |
| Total height over cab | 12ft. 3in. |
| Total height panta. locked down | 14ft. |
| Diameter of drivers | 39.37in. |
| Total weight, short tons | 92.5 |
| Motors | Six No. 350-N-6 |
| Gear ratio | 18.61 |

TABLE II.—*Ratings of Westinghouse-Baldwin-Naval Locomotives.*

| | |
|---|---|
| One-hour rating— | |
| Horse-power | 1620 |
| Tractive effort in pounds | 28,000 |
| Speed in miles per hour | 21.7 |
| Continuous rating— | |
| Horse-power | 1340 |
| Tractive effort in pounds | 21,280 |
| Speed in miles per hour | 23.6 |
| Tractive effort at 25 per cent. adhesion | 46,250 lb. |
| Maximum safe speed | 52 miles per hour |

## 15-Ton Side-Tipping Wagons.

SOME 15-ton side-tipping wagons of a new type are illustrated in the accompanying engravings, one of which shows the body tipped by means of a crane hook. The wagons have recently been designed and supplied to the Buxton Lime Firms Company, Limited, by Charles Roberts and Co., Limited, of Horbury Junction, near Wakefield, and are specially intended for use in connection with a large limestone crushing plant, which is in operation in the Peak Forest district in Derbyshire. The wagons, after being loaded at the quarries, are taken to the crushing plant, where from a high-level railway siding, the contents are discharged into a hopper feeding the stonebreaker.

The tipping of the wagon is effected by means of an electrically operated gear, which is independent of the vehicle, and which tilts the wagon body to an angle of 45 deg. To facilitate the rapid discharge and working of the vehicles, the doors are provided with a lever and link motion, which, as will be seen in one of the engravings, raises the door as the body begins to lift. When at its maximum, the opening is 5ft. wide, which provides a clear passage for large blocks of stone, some of which weigh up to 4 to 5 tons. The doors are so arranged that in the event of pieces of stone rolling and striking the bottom edge, the door can pivot and clear itself, and thus allow the stones to roll into the hopper as the body begins to tilt upwards.

The bodies of the wagons, since the vehicles have to be loaded by mechanical steam excavators, and are therefore subjected to very rough usage, are exceptionally heavily constructed. The bottom framing is of 5in. by 4in. rolled steel joists, with 8in. by 3in. channels, forming the front and back sills, and 5in. intermediate channels, all fastened together by means of knees, gusset plates, &c. The floor is laid with 3in. thick oak planks, covered by ¼in. mild steel plates, all fastened to the floor framing by countersunk bolts and nuts. The body and door sheeting is of $^{5}/_{16}$in. thick mild steel plates, and with the arrangement of bulb angle cappings, angle and plate stiffeners and gussets adopted, the whole constitutes a strong and workmanlike job.

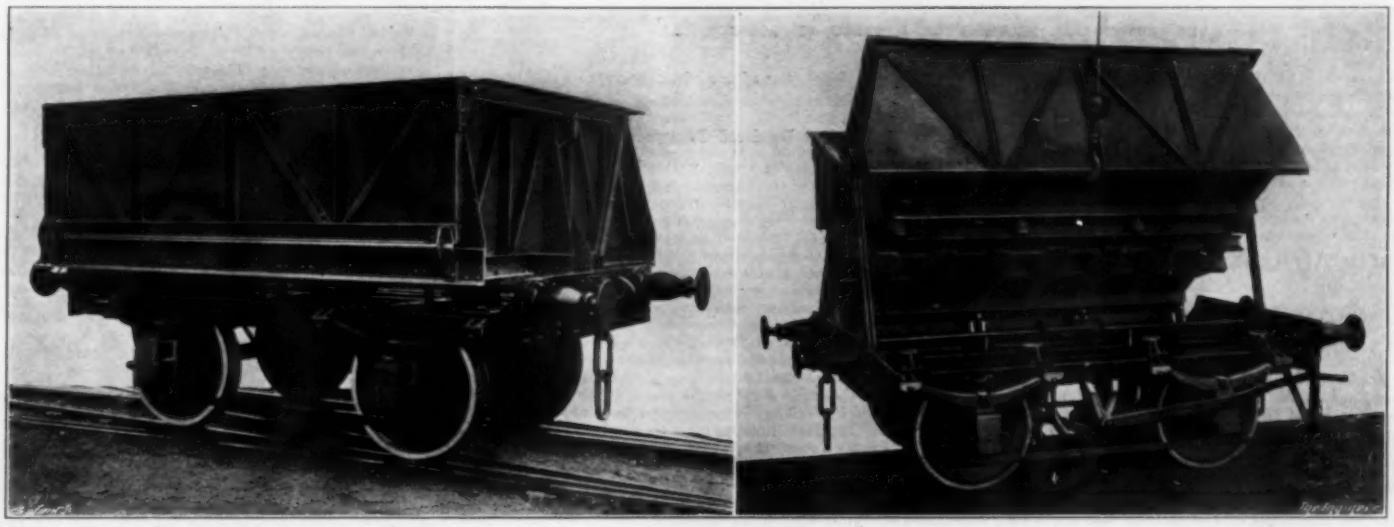
The body pivots, which are four in number, are of cast iron. They are furnished with steel pins, and are fitted with Stauffer lubrication. These pivots are arranged at the front edge of the body in such a position that the main underframe of the wagon may not be tilted on the rails when tipping is in progress. At the rear of the body there are four buffers, which are fitted with small helical springs to take up any undue shocks occasioned by the dropping of large pieces of stone, or by the dropping of the body too rapidly after the tipping operation is completed. In addition, they form distance pieces coinciding with the pivots to keep the body horizontal.

The main underframe is constructed of 6in. by 2½in. channels, with headstock of ½in. thick mild steel plates, all braced by means of gusset plates, and fastened together by means of angle and plate knees. To keep down the overall height of the vehicle the underframe was specially designed, and in order that the buffers and draw gear may coincide with standard railway rolling stock, the headstock plate is carried above the top level of the underframe, and self-contained buffers are secured to it. The draw gear is of the standard through type, with Gedges' draw hooks and three link couplings connected in the centre by means of a draw bar cradle containing a steel volute spring.

The leading dimensions of the wagons are as follows :—

| | |
|---|---|
| Length of body inside | 10ft. |
| Width of body inside | 9ft. |
| Depth of body inside | 3ft. |
| Length over headstocks | 12ft. |
| Length over buffers | 15ft. |
| Centres of buffers | 5ft. 8½in. |
| Height of buffers above rails | 3ft. 5in. |
| Gauge of rails | 4ft. 8½in. |
| Total height above rails | 7ft. 6in. |
| Capacity in cubic feet | 270 |
| Capacity in tons | 15 |

The wheels and axles are of the standard type, excepting that the wheel centres are solid, to prevent stones in the quarries wedging them, as might have occurred with spoke centres. The axles have journals, 9in. long by 4½in. diameter, and the axle-boxes, which are of the standard Railway Clearing House type, are of cast steel with white metal lined bearings, arranged for oil lubrication. The bearing springs are of the laminated type, and have six plates, 4in. by ⅝in., the spring shoes for holding them in position being arranged on the outside of the sole bars.



15-TON SIDE-TIPPING WAGON BEFORE AND AFTER TIPPING

## TERMS OF PAYMENT IN CANADA.

H.M. SENIOR TRADE COMMISSIONER in Canada (Mr. F. W. Field) has forwarded to the Department of Overseas Trade a memorandum on the terms of payment usual in Canada. He states that the terms on which the majority of Canadian buyers endeavour to do business are, as a rule, more extended than British manufacturers usually desire to recognise. In goods handled directly or indirectly through the retailer, they seek credit of thirty, sixty or ninety days, customarily extended by the established American manufacturers. It is difficult, in the face of that condition, for British manufacturers of such goods to insist on "cash against documents," or, as some do, "cash before shipment." Only the most important firms pay cash against documents. The United Kingdom trader, in order to establish or regain trade, must ascertain the terms and be prepared as a rule to allow equal terms, as regards credit, with manufacturers of similar goods in the United States.

Some United Kingdom manufacturers, he continues, have been inclined continuously to press their agents for a larger volume of business. The result has often been a more substantial number of orders, but disappointing and sometimes disastrous results in the collection of accounts. In considering the volume of trade, it must not be overlooked that Canada's population is approximately only 9,000,000, and that there is substantial Canadian industrial production and strong and intimate competition from the United States. A satisfactory arrangement should be made for local representation. Having the best possible man, obviously he should be encouraged to deal with the better firms, collections from whom cause no anxiety, rather than to think only of a large volume of trade, with little regard to credit ratings and with the inevitable costly results.

THE cooling towers of the new Johannesburg power station are being made of reinforced concrete. They are circular in form, 46ft. in diameter by 124ft. high, and the walls are 7in. thick.

## SIXTY YEARS AGO.

IN our issue of January 13th, 1865, we recorded the progress being made with the work of altering and fitting-out the steamship Great Eastern for her historic task of laying the Transatlantic telegraph cable. The great vessel had passed provisionally into the hands of the Atlantic Telegraph Construction Company, and was lying in the Medway, a short distance below Chatham. The principal work involved in adapting the vessel to her new duty consisted of fitting her with the enormous tanks required for the cable. The space for these tanks was provided by the removal of two of the decks for almost their entire length, besides clearing away certain other portions of the vessel's internal structure. The tanks, three in number, were constructed by the London Engineering Company. One, the largest, measured 58ft. in diameter and 20ft. 6in. in height, and was cable of holding 800 to 900 miles of cable. It was placed in the after part of the ship, and occupied the space formerly devoted to the second-class saloon. The 'midship tank held about the same length of cable. The forward tank could accommodate 600 to 700 miles. Steps had to be taken to strengthen the decks on which the tanks were placed, and the tanks themselves had to be supported to enable them to resist the lateral pressure exerted on their walls by the cable when the vessel rolled. The three tanks held a total of 2253 miles of cable, but it was intended to place on board a length of 2400 miles, in order to allow for slack. About 800 miles of the cable had at the date of writing been completed at the works of Glass, Elliot and Co., the rate of progress being about 100 miles a week. It was expected that the shipping of the cable would be completed and the vessel made ready for sea by June, 1865. There was no foundation, we added, for the rumour that the vessel had been disposed of to the French Government. The expedition, it may be added, ended in temporary failure, for the cable parted after more than half the total length had been covered. In the following year, however, a second cable was laid without mishap, and the first was successfully spliced and completed. . . . In a paragraph in the same issue we read that the owner of a self-propelled steam thrashing machine had been prosecuted and fined for contravening a recent order of the Home Secretary prohibiting the movement of locomotives along highways except between the hours of midnight and 6 a.m. The owner submitted that he was merely trying the machine after it had been repaired, an operation which could not properly be conducted in the dark. The bench fined him only 1s., not because of this excuse, but because his was the first case under the order. The police were instructed to inform the toll-bar keepers that they must warn all parties passing through with steam engines that proceedings would be taken against them.

## LAUNCHES AND TRIAL TRIPS.

OUED MELLAH, oil tanker ; built by Philip and Son, Limited ; dimensions, 140ft. by 30ft. by 9ft. 6in. Engines, 13½in., 28in. by 20in. stroke ; constructed by the builders ; launch, December 8th.

CABIMAS, oil tank steamer ; built by Palmer's Shipbuilding and Iron Company, Limited ; to the order of the Gulf Refining Company ; trial trip, December 11th.

ROGER BECK, steel screw pilot cutter ; built by the Amble Shipbuilding Company, Limited ; to the order of the Swansea Pilot Boat Company, Limited ; trial trip, December 11th.

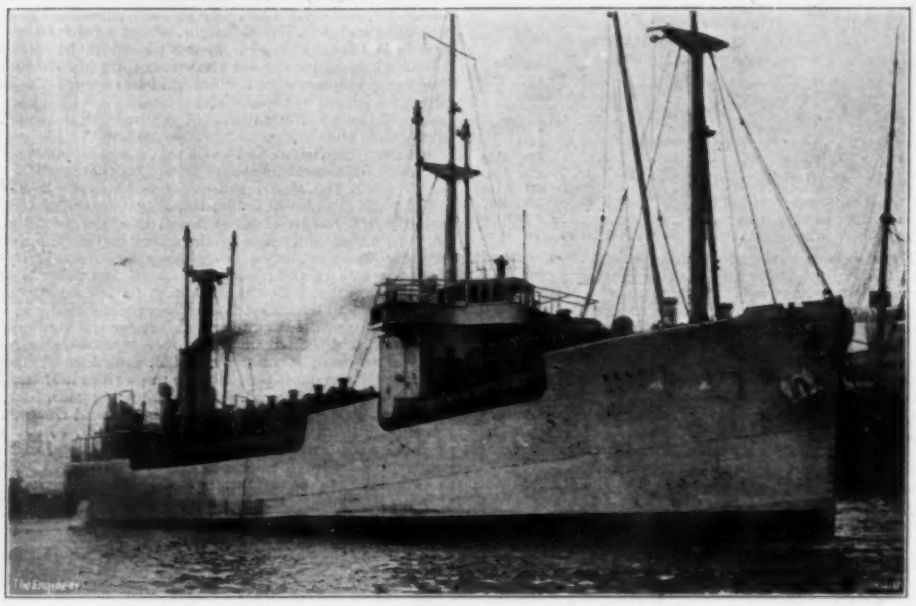
KANTARA, single-screw steamer ; built by Barclay, Curle and Co., Limited ; to the order of James Moss and Co., Limited, of Liverpool ; dimensions, 331ft. by 40ft. 6in. by 25ft. 6in.; 3610 gross tonnage. Engines, triple-expansion ; constructed by J. G. Kincaid and Co., Limited ; launch, December 29th.

CITY OF MANDALAY, single-screw steamer ; built by Swan, Hunter and Wigham Richardson, Limited ; to the order of the Ellerman Lines, Limited ; dimensions 443ft. by 57ft. 6in.; to carry, 11,450 tons. Engines, inverted direct-acting triple-expansion, pressure 225 lb.; constructed by the Wallsend Slipway and Engineering Company, Limited ; trial trip, December 31st.

VERA RADCLIFFE, steel screw steamer ; built by Craig, Taylor and Co., Limited ; to the order of Evan Thomas Radcliffe and Co. ; dimensions, 430ft. by 55ft. 6in. by 30ft. 7½in. Engines 28in. 46in., 75in., by 48in. stroke, pressure 180 lb. ; constructed by Blair and Co., Limited ; trial trip, January 7th.

## Shipping Locomotives.

IN our annual review of locomotive building during 1924, we referred to a batch of 4–6–0 locomotives with eight-wheeled tenders which had been made for the East Indian Railway Company, by the Vulcan Foundry, Limited, of Newton-le-Willows. To-day we reproduce a photograph which shows a batch of these locomotives on board the motor ship Beldis, which left Birkenhead on Christmas Day for Calcutta. The Beldis is the property of Christen Smiths Rederi, of Oslo, Norway, and was specially constructed for the conveyance of locomotives in the assembled condition. Thirteen completed locomotives



THE MOTOR SHIP BELDIS WITH A CARGO OF LOCOMOTIVES

were stowed on her deck, whilst four others and seventeen tenders were stowed below. Altogether forty of these locomotives are being supplied to the order of the East Indian Railway Company, whilst two more are to go to the Madras and Southern Mahratta Railway, and two more to the Nizam's Railway.

## South African Engineering Notes.

### Railway Electrification in South Africa.

DURING the last session of the Union Parliament of South Africa a further sum—though but a small one, it must be admitted—was voted for the Cape Peninsula Railway electrification scheme. As far back as 1917 Messrs. Merz and McLellan, consulting engineers, reported upon the railway electrification. As a result of that report Parliament provided funds for the electrification of the section of the Natal main line from Durban to Pietermaritzburg, including the original line and deviations and the lines to the Point and Bluff. The electrification of the Natal portion of the railway was forthwith commenced and the section Glencoe-Pietermaritzburg is so well in hand that it is anticipated the whole scheme will be completed about the middle of this year. The financial position, however, necessitated the postponement of the electrification of the Cape Town-Simonstown line, and that has only within the last few months been begun.

Apart from the general advantages which follow the introduction of electrification in busy suburban areas, the conversion of the Cape Town suburban lines must be considered as a necessity in order that the travelling facilities may keep pace with the growth of traffic. Under present conditions it is not possible to increase the number of trains on the suburban lines into and out of Cape Town station during the morning, midday and evening rush periods. To widen the railway right of way would not only be difficult, but would involve a large expenditure in the acquisition of land, residential property, &c. Electrification will avoid this and it will also give greater frequency of service, as the trains running are to be increased by 25 per cent., while the speed will be increased by about 25 per cent. The estimated capital expenditure for the electrification of the Cape Town-Simonstown and the Monument-Sea Point and Monument-Dock lines is £759,375.

The multiple unit system, which is in general use for suburban electrification, is to be adopted. Power will be transmitted from the power station, to be erected at Salt River by the Electricity Supply Commission, over duplicate high-tension three-phase lines to sub-stations situated near the railway track, from which power will be supplied to trains at 1500 volts direct current by means of overhead conductor wires.

### World's Greatest Copper Producer.

The Union Minière Company of the Belgian Congo now claims to have attained to the position of being the leading copper producer in the world. In August the company secured an output of 9250 tons. The next largest producers are situated in North and South America and their names and recent monthly productions are as follows:—Utah Copper, 8839 tons; Chile Copper, 8258 tons; and Anaconda, 8055 tons. Recent copper outputs of the Union Minière have been as follows:—Output for 1921, 30,464 tons; 1922, 43,362 tons; 1923, 57,886 tons; March quarter, 1924, 16,680 tons; June quarter, 1924, 19,851 tons; July, 8525 tons; August, 9254 tons. It will be seen from this that the output of the Belgian Congo mines for the first eight months of last year was no less than 54,310 tons, as compared with 57,886 tons for the whole of last year. No small portion of the recent large production was secured from the Ruashi mine, which lies three or four miles from the old Star of the Congo property, and was discovered two or three years ago. The Ruashi mine has proved itself to be yet one more wonder in a country endowed with mineral riches to an almost fabulous degree, and it is said that in August it yielded 9000 tons of ore of an average copper content of 30 per cent.

### The Dutton Road-rail Transport System.

One of the most successful innovations in the railway service of the Union of South Africa is the Dutton road-rail transport system which was put into service in October between Naboomspruit and Singlewood, two points in the Transvaal Province situated 20½ miles apart as the rail runs. The approximate total cost of construction was £23,000, of which £2000 went in the provision of causeways. One of the outstanding features of differentiation between the ordinary railway and the road-rail is that the latter requires no heavy sleepers to carry the engines, while the rails may be 12 lb. or 16 lb. The road bed on either side of the rails is prepared as a wheelway for the tractor. The front wheels of the tractor are placed on a bogie which runs on the rails for the purpose of guiding only, the weight of the engine being carried by large rubber-tired wheels. The fact that the tractors can leave the rails and travel along a road means that at any time, if desired, they can draw loaded wagons from farms, returning to the track to remount the lines and haul the produce, now transferred to trucks, to Naboomspruit for transshipment to the main line train. There is a refreshing informality about the road-rail service, inasmuch as the train may be pulled up at any point along its route for the loading up of farm produce.

At the opening of the track the Minister of Railways said that the road-rail system might furnish the solution of a great problem as regards the additional transport needed to further the development of the Union. It might adequately meet the requirements of certain sparsely populated areas. Even before the formal opening the road-rail service had carried 32,000 bags of maize and peanuts, besides other goods traffic and a passenger coach, specially constructed, will be put in service shortly. The import and commercial significance of the Naboomspruit-Singlewood road-rail may be gauged from the fact that the area served is said to be about 300 square miles in extent. Since the decision to construct a Dutton road-rail across the Springbok Flats there has been a marked increase in the demand for farms in that area. Applications have been received by the Minister of Railways for extension of the road-rail to Roedtan (seven miles), for a light track to run from a point on the existing road-rail for some ten miles, and for the provision of a road-rail northward of Roedtan, to assist farmers on the northern section of the Springbok Flats.

### Transvaal Gold Output.

The gold production of the Transvaal for September was 799,422 ounces, a decrease on August of 10,149 ounces, while the value was £3,677,341, a decrease of £6207. Seeing that both months had the same number of working days—twenty-six—the results were disappointing, especially in the case of the total value of the output, seeing that the price of gold was taken at 92s. per ounce in September, against 91s. in August. The October output of gold was the highest in the history of gold mining in South Africa. The total quantity was 827,583 fine ounces, of which the Rand's share was 807,419 ounces and that of the "outside" districts 20,164 ounces. It is true that the quantity returned for March, 1912, was 830,723 ounces, and for July of last year 829,427 ounces; but in the first case 70,000 ounces had been in reserve and were brought into account in March by a special clean-up. In the case of last July 16,975 ounces, which were included in the total were the result of the trial run of the plant during the latter part of April, and through May and June, as is expressly stated by the Chamber of Mines. Therefore the October output of 827,583 fine ounces was not less than 15,121 ounces more than the previous highest record. The November returns for the gold industry showed the total production for the month was 802,313 fine ounces, which was 25,270 ounces below the October figure, while the value £3,570,293 was £215,899 less than that returned for the previous month. The reduction was partly attributable to the fact that the price of gold showed a fall of 2s. 6d. per fine ounce being taken for November at 89s. From the point of view of daily average output, however, November compared most satisfactorily, for, owing to there being five Sundays in the month, there were only 25 working days against 27 in October, so that the daily average worked out at 32,092 ounces, whereas the average for October was but 30,651 ounces, or 1441 ounces per day less. The November average has certainly not been equalled for years, and may probably be taken as a record for the industry. The eleven months' gold output last year reached the value of £39,950,695, which is £3,716,542 higher than the total for the eleven months of the previous year. Up till the end of November the Rand gold mines had earned profits totalling over £13,300,000. This is an increase of over £2,000,000 on the profits for the same period of 1923, and £700,000 more than the total for the whole of that year.

## CALENDARS, DIARIES, &c.

LANCASHIRE UNITED TRAMWAYS, Limited.—Wall calendar with tear-off sheets.

PECKETT AND SONS, Limited, Bristol.—Wall calendar with monthly tear-off sheets.

ROYCE LIMITED, Trafford Park, Manchester.—Wall calendar with monthly tear-off sheets.

RUSTON AND HORNSBY, Limited, Lincoln.—Two wall calendars with monthly tear-off sheets.

CROFTS (ENGINEERS), Limited, Bradford.—Wall calendar with monthly tear-off sheets.

H. J. SKELTON AND CO., Limited, London, E.C. 2.—Wall calendar with daily change card.

URQUHART, LINDSAY AND ROBERTSON ORCHAR, Limited, Dundee.—Wall calendar with weekly tear-off sheets.

WALKER VEHICLES, Limited, Caxton House, Westminster, S.W. 1.—Desk calendar with weekly tear-off sheets.

*Chemical Trade Journal and Chemical Engineer*, 265, Strand, W.C. 2.—Wall calendar with monthly tear-off sheets.

THE IRONITE COMPANY, Limited, 11, Old Queen-street, Westminster.—Wall calendar with monthly tear-off sheets.

C. ISLER AND CO., Limited, Bear-lane, Southwark, S.E. 1.—Wall sheet calendar with the whole of the year at sight.

ENGLISH ELECTRIC COMPANY, Limited, Queen's House, Kingsway, W.C. 2.—Desk calendar with daily tear-off sheets.

WEST HAM TESTING LABORATORY, Baythorne House, Gordon-street, Plaistow, E. 13.—Desk calendar with daily tear-off sheets.

GREAT WESTERN RAILWAY COMPANY, Paddington.—Art calendar with picture in colours of Isambard Kingdom Brunel. Weekly tear-off sheets.

WM. BROWN AND CO., Limited, 2, Bury-court, St. Mary Axe, London, E.C. 3.—Wall calendar with monthly tear-off sheets. An ink photo print of the Old Curiosity Shop by J. C. M. Piko is reproduced.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are informed that Mr. John F. Avils, A.M.I.E.E., A.M.I. Mech. E., has joined the firm of Messrs. John Sterling and Co., of 66, Victoria-street, S.W. 1 (telephone: Victoria 2635; telegrams: Equisterl, Sowest London).

WE are asked to state that the Mining Engineering Company, Limited, of Moorfields, Sheffield, has purchased several acres of land at Worcester and will shortly be erecting works there to cope with the expansion of its business.

MR. GEORGE WHITE, B.Sc. (Glasgow), assistant to the Professor of Civil Engineering in Queen's University, Belfast, has taken up a post as lecturer in civil and mechanical engineering in the Plymouth and Devonport Technical Schools.

CUIRASS PRODUCTS, Limited, informs us that it has moved its offices from 69, Victoria-street, Westminster, S.W., to Abbey House, Victoria-street (entrance Tothill-street), London, S.W. 1. Its new telephone number is Victoria 5419 and its telegraphic address "Kwerasspro, London."

WE are asked by the Faraday Society to state that Messrs. Gurney and Jackson, of 33, Paternoster-row, have been appointed its official publishers, and that in future they will deal with all business relating to the sale of "Transactions" and separate reports of general discussions.

THE Council of the Institution of Gas Engineers has nominated Dr. Charles Carpenter, C.B.E., M. Inst. C.E., president of the South Metropolitan Gas Company, for the award of the Birmingham Gold Medal, which is the highest distinction conferred for services rendered in the science and practice of gas engineering.

THE Ministry of Transport announces that Mr. Harry Booth is retiring from the office of Electricity Commissioner on January 24th, after completing over forty years in the public service. The Minister of Transport has consented to his services being retained by the Electricity Commissioners in a consultative capacity for a period of twelve months.

AFTER holding the position of works manager of the English Electric Company at Stafford for the past two years, Mr. A. H. Sturdee is leaving to join the engineering firm of Ruston and Hornsby, Limited, as chief works manager of that company's five works at Lincoln. He is to be succeeded at Stafford by Lieutenant-Colonel C. Hardie, D.S.O., of London.

WE are asked by Mr. T. Roland Wollaston, of Lord's Chambers, 26, Corporation-street, Manchester, to state that a private company—Wollaston Gas Producers (Manchester), Limited—has taken over his office, as above, and his present staff, and will hereafter carry on business in so far as it relates to his recovery and non-recovery gas producers, producer-fired steam boilers, and water purification plant, under the joint control of Mr. A. V. Wallwork as commercial manager and himself as technical manager.

# Provincial Letters.

## THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

### Trade Situation.

IRON and steel masters in the Midlands and Staffordshire express disappointment at the amount of business which resulted from last week's quarterly meeting and which has not strengthened their position very much. There was an absence of big scale and forward buying, practically all the orders forthcoming being to satisfy current needs. With no prospects of higher prices, consumers are ordering only just what they want at the moment, but even that is finding business for an increasing proportion of mill plant. There is a general expectation that the gradual expansion of business which marked the last quarter will be continued, but the brisker buying is not developing so promptly as some of the optimists hoped for. With only small orders to be picked up producers of iron and steel adhere to late quotations for the most part, hoping a new impulse will make itself felt in the near future. While so far this month new business in any of the Midland industries has been scarce, the principal trades are well employed upon orders received towards the close of last year. Staffordshire iron and steel producers are beginning to benefit, though as yet only slightly, from the substantial rolling stock contracts the leading firms received a month or so ago. The latter have sufficient orders on hand mainly for the home railways, to keep them employed during the first six months of the year.

### Finished Iron Position.

The Staffordshire finished iron trade has not improved its position very much as the result of last week's quarterly meeting, orders, except in the case of best grade iron being scarce and small. Makers of best bars have a fair amount of work on hand and good prospects. This high-class iron is in good demand for various engineering requisites, high quality chains, &c. Crown bars are in poor demand. With regard to the offers of medium grade iron from France it is understood that several small experimental orders have been placed. The trade in Staffordshire nut and bolt iron does not show improvement, and £11 15s. is still quoted. An increased tonnage of steel is going into nut and bolt manufacture, the explanation being the lower price of steel compared with iron. The present price of Staffordshire bar iron renders competition with steel in most cases quite impossible, and it is difficult for ironmasters to make ends meet, in view of the standing charges, without much heavier production than is now possible. Belgium continues in control of the common bar trade by virtue of the much lower prices at which, with the assistance of the exchange, she is able to put her products on the market. For many years past, Belgian bars have been imported into the Black Country in greater or lesser quantities, according to the state of the industry here and the prices which Staffordshire mills were prepared to accept. But the difference of price is much greater now than in pre-war days, something like £4 even when the freight has been paid, so that very little big scale business is going to local mills, except where special qualities or sizes are required.

### Wolverhampton Ironworks to Close Down.

The discouragement in the South Staffordshire iron trade, which has been under a cloud of depression for some years, has been accentuated by the announcement that George Adams and Sons, Limited, of the Mars Ironworks, Wolverhampton, and the Cleveland Ironworks, Horsley Field, Wolverhampton, have decided to close down and go out of business, in consequence of the unsatisfactory trading conditions now prevailing and the continued depression. The firm has had a long and honourable connection with the Midland iron trade, and is one of the best known in the key industries of the Midlands. It was founded in 1867 by Mr. George Adams, of Wolverhampton, and for many years traded very successfully. Trade has, however, languished in recent years, and during that time several other well-known South Staffordshire firms have gone out of business. There are now four works in course of being dismantled or about to be. The decision, which is generally regretted, will affect 620 men, of whom 500 are engaged at the Mars works, and 120 at the Cleveland works.

### Steel.

All the local steel makers are rather busier, but there has been no such influx of orders as would re-animate the finished steel branches. There is a keen inquiry for specifications, which in a number of departments are scarce. The prices of finished steel have scarcely been maintained, £9 5s. being now seldom quoted for small steel bars. The general figure is about £9. It is said that sales have been made at £8 17s. 6d., and it is believed that a good specification would be promptly accepted at this figure. There is still a large amount of unemployed plant and, with the present highly efficient equipment, large orders are quickly disposed of. The situation in the tin-plate trade is affecting the steel works, and is introducing an element of weakness into the steel department. Competition is very keen and, whereas a few weeks ago £9 5s. was the recognised standards for joists, sections, &c., £9 is now very often quoted. As specifications are scarce an order for immediate rolling would be accepted by some firms at £8 17s. 6d. The mills badly want orders for heavy tonnage, such as rails. Foreign supply of steel is restricted. Quotations are readily available, but delivery cannot be promised under two or three months, and the usual experience is that still longer terms are necessary before the steel is available. Large orders would be accepted for billets at £6 7s. 6d.; most descriptions of foreign steel are dearer by about 5s. per ton than at the end of the year, and the narrowing margin between foreign and native steel, combined with the slow delivery, is diverting more business to the native mills. The partial slump in tin-plate has reduced the demand for semi-finished steel from the Welsh mills, and although £7 5s. is still quoted for billets by some firms, there are those who quote as low as £7.

### Galvanised Sheet Prices.

Galvanised sheet mills, though well employed, have been unable to maintain the advance of half a-crown recently made in quotation for 24-gauge corrugateds. The highest quotation at date would appear to be £17 5s. f.o.b., but some sellers are prepared to accept £17 2s. 6d. and the major portion of the business passing is at this figure.

### Tinned and Lead-coated Sheets.

The Tinned Sheet Manufacturers' Association has reaffirmed prices at £58 per ton for best charcoal, £56 for charcoal, and £52 for unassorted grades, to 20 gauge in each case. Makers of lead-coated sheets have re-declared the old price £28 per ton to 20 gauge.

### Manufacturers and Steel Houses.

Two steel houses which are in course of construction by the Public Works Committee of Birmingham City Council will occupy sites in the British Industries Fair at Birmingham next month. Special invitations are being issued by the Lord Mayor of Birmingham to other municipalities to come and inspect them. Further, the Fair authorities are calling the particular attention of manufacturers to this feature, in order that they may take advantage of the excellent opportunity presented of judging which component parts are best suited for manufacture in their own works. It is believed that many Midland firms will be able to utilise in this way portions of their factories which are not at present in full activity.

### Pig Iron.

Midland pig iron prices remain unchanged, and with coke plentiful and fair stocks no rise in raw iron prices is looked for. Some of the Derbyshire and Northamptonshire furnaces have made sales into April. There is talk of re-commissioning several furnaces in the district, but everything depends upon the development of demand and the probabilities of a fair reward for enterprise. The attitude of the coke suppliers is causing concern. Some furnaces have only been able to renew their coke contracts at a substantial advance, and market quotations are not encouraging to those who believe that the iron trade can only be revived with the assistance of cheap coke.

### Coke.

The steadiness of coke is the most important element in the pig iron situation, promising further stable prices on the present basis. With reducing exports, there is plenty of this fuel available, and it is difficult to see how the price can be advanced. Moreover, the coke makers, it is thought, will be cautious in avoiding anything likely to hinder the pig iron revival.

### Engineering Business.

Fresh contracts are badly needed by constructional engineers in this district. The steady improvement in business recorded of late by mechanical engineers is being maintained, and the machine tool trade is similarly placed. Electrical engineers are favourably situated, the electrical industry continuing to make rapid strides. A great extension of facilities has been effected by local authorities in Birmingham and elsewhere in the Midlands. Independent generating plants have likewise been installed by a number of manufacturers. Electrical engineers have not found the demand for small industrial motors developing as fast as had been expected, but there is a quickening tendency. Makers of gas and electric light fittings in this area continue to benefit from the numerous housing schemes now being carried through.

### Derbyshire Miners' Wages Dispute.

At a special meeting of the Derbyshire Miners' Council at Chesterfield, on Saturday last, consideration was given to the offer of the owners of the soft coal collieries in Derbyshire and Nottinghamshire to restore the 7½ per cent. wages reduction on condition that a separate Wages Board for soft coal pits was established. The Council decided not to accept the offer, and that notices should be handed to the colliery companies for the men to cease work on January 27th. Twenty thousand men are affected. It is stated that at least one colliery company has intimated its willingness to refund the 7½ per cent. reduction without the proviso, and it is thought that in the event of a strike work will continue at its collieries.

### Stafford's New Works.

I learn that the works to be erected at Stafford, by the British Reinforced Concrete Engineering Company, Limited, will comprise a series of parallel single-storeyed bays, each about 70ft. wide and several hundred feet in length. The buildings will be steel framed with the permanent walls of reinforced brickwork and the works office, engineers' shop, engine shed, &c., will be constructed of reinforced concrete and reinforced brickwork.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

### General Outlook.

THERE is a better feeling in trade circles here this week, although it cannot be said that the actual business done has come up to expectations. Much was expected from the Birmingham quarterly meeting on January 8th, but this optimism seems to have been misplaced. The consequence is that the results of that meeting have been disappointing. There seems to be no doubt that the iron and steel trades of the country will have to be satisfied with a very slow movement towards improved conditions, and that perhaps even the non-ferrous metal trades must not look for anything very rapid. It is, however, not to be denied that the prospects for industrial revival this year are better than they were last year, and, at any rate, we are another year further away from the wreck of all industrialism caused by the Great War. It took nearly seven years to recover from the Franco-German War of 1870, so that ten or twelve years for recovery from the last war is not an extravagant estimate.

### Metals.

There is a feeling of considerable confidence here in the non-ferrous metal markets, and this does not seem to be much affected by the slight setbacks which occur from time to time in the prices. So far as copper is concerned, one cannot very well expect to see a continuous rise without any check, so long as the productive capacity is in excess of the world demand; and no doubt that is the case at the moment. It has to be recognised, on the other hand, that the world demand for copper is steadily growing, and the time should not be far distant when it equals the practical output. There is, of course, another influence which is temporarily against the advance in copper prices, and that is the movement of the Anglo-American exchanges towards parity. A movement of 5 per cent. upward in sterling means over £3 per ton in copper prices, and if there had been no appreciation of sterling during the last three months, the London price for standard copper might now have been over £70 per ton. The industrial demand for copper in Manchester is rather better than it was, and merchants have obtained over £72 per ton for refined ingot in this district. Fine scrap copper, such as fire-box plate cut up into convenient pieces, also fetches a high price; and it is to be noticed that dealers are beginning to offer much better prices for the scrap metals. In the scrap market, however, old gun-metal lags behind, and can be bought still on very reasonable terms. There are firms in the trade who are beginning to realise that this class of scrap metal is too cheap, and who are endeavouring to accumulate stock while the depression lasts. The rather sharp fluctuations in tin continue and a movement of £3 to £4 per ton in a day is not uncommon; but, on the whole, tin seems to gain in strength, and the optimistic view in the market persists in the face of larger shipments. It is believed that these shipments must very soon decrease, now that the reserve stocks are exhausted. The lead market has so far failed to answer the expectation of those who were predicting a level of £50 for English pig lead. Nevertheless, it would be rash to dogmatise about the position, for anything may happen yet.

### Pig Iron.

The market here for foundry iron is scarcely so good as was expected this week. Perhaps too much was anticipated from the meeting of the trade in Birmingham, and at the moment people may be suffering from disappointment, but so far as prices are concerned, there is no weakening here yet. One notices a little more inclination to buy, and it seems to be generally assumed that foundry iron prices are not likely to go much lower unless furnace coke can be reduced. The agreement as to coke prices has expired, but furnace quality has still been selling on the old basis of 16s. 6d. Holders of Derbyshire No. 3 iron quote 90s. delivered here, and will accept orders up to March, but one does not hear now of any cutting below this price. Northamptonshire iron may perhaps be bought in Manchester at 88s. 6d. and 89s. per ton delivered, but the quality is not a favourite one in this district, and a bigger reduction would be needed to effect large sales. East Coast hematite iron remains comparatively cheap at 100s., while Scotch No. 3 foundry keeps at 107s. 6d. One does not hear yet of any revival in the demand for textile machinery castings, and, in fact, the foundry trade here generally seems to be troubled with too much internal competition.

### Steel.

So far there has not been any sign of improving conditions in the finished steel trade here. If anything, the market seems to be a little weaker than it was, and suffering from a keener competition. One hears, for instance, that orders for sections have been placed at £8 15s. delivered free in this district; but one cannot say whether or not the specifications were particularly favourable. Of course, it has been known for some time that an order for a large quantity of one section could be placed at under £9. The nominal price for joists and angles here is still £9 per ton, and for plates and flat bar steel £9 15s. For round bars £10 to £10 5s. per ton is usually quoted. There has been some talk about a fine quality of French bar iron at prices some £3 below the ostensible price of Crown quality here, but one has not yet heard the result of any experiments with these bars.

### Scrap.

The market here for wrought scrap has been rather firmer, but no doubt this is because of the comparative scarcity of good quality. Of course, wrought scrap is the cheapest material for the malleable ironworks, so long as the price keeps near to that for forge pig iron, but the total consumption, whether of scrap or of pig iron, in the Lancashire iron trade is, of course, only small. What the trade needs is much lower overhead costs for the manufacture of malleable iron. Steel scrap is in a hesitating mood. Dealers have paid 70s. for good heavy scrap in Lancashire, but the consuming markets do not yet seem to be up to that figure. For foundry scrap there is a moderate demand, but no change in prices; dealers usually quote 85s. per ton for good ordinary machinery castings, and 90s. per ton for cast scrap from textile machinery.

### Peace Productions at Barrow-in-Furness.

By the courtesy of the directors of Vickers Limited, I have recently had an opportunity of inspecting the works of that company at Barrow-in-Furness, which during a quarter of a century, up to the date of the Armistice, had been devoted almost exclusively to naval shipbuilding, engineering and ordnance. The chief object of

my visit was to observe how this great establishment had been adapted to the production of peace products; for the building of warships and guns is vastly different from the construction of merchant shipping, while the turnover to general engineering products involves an immense amount of reorganisation and new plant. The period which has elapsed since the conclusion of the war has been full of anxiety for firms the products of which were previously of a warlike nature, and it has required considerable faith in the future and self-confidence on their part to take up and develop other branches of engineering work which have little or no connection with armaments. The transition period involves a heavy financial stress which can only be successfully overcome by the utmost economy coupled with clear, cool headedness on the part of those in charge in deciding upon future plans. It was only natural that the company's first thoughts should be largely concentrated upon commercial shipbuilding, and in this connection the Barrow works have met with success in many directions, in spite of all-round depression in the shipbuilding industry. Since the war Messrs. Vickers have turned out from Barrow vessels for British and colonial owners, varying in displacement between 27,000 tons and 10,000 tons. At the present time they have on the stocks four vessels, three of which are for the mercantile marine, and a cruiser for the British Government. One of the ships is for the Cunard Company, one for Furness, Withy and Co., and the third for the Orient line. The last named is a sister ship to the Orama, and has a displacement of 20,000 tons. The Moveria, which has just been completed and goes on her trials this week, has been constructed for the Donaldson Line for the frozen meat trade. She has a gross tonnage of 5000, and is propelled by an eight-cylinder single-acting four-cycle solid injection oil engine of 2700 brake horse-power, driving a single screw. Engines of similar design but with only six cylinders and with a horse-power of 600 have also been built at Barrow for Japanese owners. It need scarcely be repeated that the shipbuilding works are equipped with the most modern machinery and appliances for undertaking the construction or repair of all kinds of craft. They are conveniently situated, and the foreshore of Walney Channel affords sheltered berthing and good launching facilities. The tower crane equipment is capable of handling the heaviest materials used in vessels of the largest size. The machine shops, mould loft, frame and plate sheds, cover a very large area. The woodworking departments have been greatly extended and reorganised to be able to deal with the large amount of structural and decorative furnishings with which modern passenger vessels are fitted. There are also commodious docks for fitting out and completing vessels after launching, cranes of 150 tons capacity being provided, a floating dock capable of lifting vessels up to 5000 tons weight and a graving dock 500ft. long. Turning to general engineering work, I may say that the shops at Barrow-in-Furness are now fairly busy, and the variety of the products upon which they are engaged gives evidence of a spirit of enterprise on the part of the management. Passing through the boiler shops, which, by the way, are much busier than might be expected, I saw in course of construction boilers of the Vickers-Spearing water-tube type for land purposes, marine boilers of various kinds, and locomotive boilers in large numbers, the last named being part of an order for the London, Midland and Scottish Railway. One of the large engine shops has been adapted for the building of hydraulic turbines, a branch of engineering which Messrs. Vickers are making a speciality of up to very high powers. The largest plant of this type yet built is one of 25,000 horse-power. Several large plants of this kind, with electric accessories, are now in progress. I also noticed a large amount of condenser work on the floors. This is another branch which the Barrow works is developing, the company having taken up the patent rights of the Contraflo type of condenser, which is equally adaptable to land and marine purposes. One surface condensing plant which came under observation was of 20,000-kilowatts capacity, and is built with a steel shell. In another department of the works I noted a number of equipments for oil-well operations. For some time Messrs. Vickers have been actively engaged upon colliery plant, and at the present time large electric winding equipments are in course of construction for the Horden Colliery, Castle Eden, amongst others. One such plant which has been turned out is said to be one of the largest in the world, being of 2400 horse-power; the electrical equipment for these plants is provided by the Metropolitan Vickers Electrical Company, Limited, Trafford Park. Cement making machinery, crushing plant and pulverisers form a further branch of activity at Barrow, and special plant has been put down for the production of tube mills, which are built up to 36ft. in length of one sheet of steel. It would be quite impossible to mention all the products which were seen in progress in a brief visit, and time did not permit of an inspection of the large works, formerly the shell shop, which has now been given over to the International Combustion Engineering Company for the construction of pulverised fuel plants, but the general impression left on the mind was distinctly favourable, and although the shipbuilding shops are far from being fully employed under the conditions which prevail generally, the company is to be complimented on the successful manner in which it has taken up and developed the manufacture of peace products. Some ten thousand persons are at present engaged in the various departments at the Barrow works, that being, about two-thirds of the number employed before the war.

### The "Mechanicals" Graduates.

The graduate section of the North-Western branch of the Institution of Mechanical Engineers is having a very successful session, and is to be congratulated upon the manner in which its meetings are conducted. I was present at the meeting held at the Engineers' Club, Manchester, on Thursday, the 8th inst., when Mr. E. H. Lewis, M.Sc., presented a paper on "The Reduction of Factory Costs." The author dealt very efficiently with his subject under four headings, the means for ensuring low cost, the utility of time study data, duties of the costing department, and the position of this department in the factory. Mr. Lewis enumerated the five factors which govern the factory cost of an article, namely, quantity, price of material, the time spent in manufacture, and rates of labour, wages and overhead charges. He said that the process department should be responsible for seeing that the labour and machines are utilised in the most efficient manner, and should also recommend any new machine or alteration which may be required in order to turn out the products economically. He said the objection might be raised that the introduction of a separate department to deal with special duties of the management might result in the inefficiencies associated with "red tape," but this could be avoided if each man had the breadth of outlook to recognise when the requirements of another department were of greater importance to the work of the organisation as a whole than those of his own department. The author said experience had shown that it paid to employ a special department to be responsible for the expenditure on labour. Such a department depended for its success upon the confidence it inspired and the co-operation it received from the other departments of the factory. Working along the lines indicated, the process department could save an amount several hundreds per cent. in excess of that spent upon it. The discussion which the various points in the paper gave rise to showed that there is much more interest being taken in economic management amongst young engineers than might have been expected, while the quality of the speeches was quite creditable, and justifies the policy of the Institution in the formation of the graduate sections.

BARROW-IN-FURNESS.

### Hematite.

The hematite pig iron trade continues to show signs of better confidence, and yet it would be absurd to say that the market is brisk. It is not. Comparatively speaking, it is only fair, but after the lengthy spell of quietness, the better activity is welcome, though its buoyancy should not be overstated. Buyers in many cases are still inclined to place orders for just their immediate wants. There are other customers who are feeling more confident and who are placing larger orders with a view to the future. The first real signs of a good step up in the trade will be a stiffening of prices, which has not occurred yet, although it is certain to come if business goes on improving, as we all hope it will. The American business is enabling many makers to keep stocks down, and there is still hope for this trade getting bigger. The continental trade is only moderate, the demand not being big by any means. What is being sent away is not in big parcels.

### Iron Ore.

The iron ore trade remains the same as regards local sorts, with the possibility of further improvement in the future. There is a little more going out of the district now. Foreign ore is experiencing a better market to a certain extent. The hopes of recovering the 5000 tons of Spanish ore which went down in the Western Valleys off Heysham are very remote. The vessel broke her back, and she has now settled down some 20ft. in the loose sand for which Morecambe Bay is notorious.

### Steel.

There is not much being done in the steel trade as yet, and the continental makers are making it difficult for local firms to obtain orders. Workington rail mills are idle this week, but the Barrow rail mills are engaged. Fresh orders would be very welcome to both towns. The small section mills and hoop mills are experiencing a fairly good trade, which keeps them going regularly.

## SHEFFIELD.

*(From our own Correspondent.)*

### Increased Output Expected.

ALTHOUGH orders for steel are not coming in freely, it is evident that the makers are expecting business, for they are now ordering more raw materials, and in some cases are pressing for early delivery. About half of the open-hearth furnaces are in commission again. Stocks of billets are, if anything, on the light side, and as soon as the demand justifies it, other furnaces will be re-started. The call for acid steel is greater than that for basic, but both are viewed optimistically. The year has made a good start in the iron and steel scrap market. Nothing in the nature of a "boom" is being experienced, but there is steady buying and inquiry, and the whole market has a healthier tone than has been the case for some time. This is a good sign. Prices are firm, and with the belief of better trade ahead, buyers are showing a desire to replenish their stocks at current rates.

### Engineering Departments.

Greatly increased activity is noticeable in the railway departments, and it has been found necessary to put some of the plant on to full time working, owing to a rush of orders for which early delivery is required. A few foreign orders and ordinary repair and renewal work were keeping the departments moderately busy, but the additional contracts placed by the home railway companies have been very acceptable, and the railway plants expect to be kept well employed for some time ahead. Locomotive and machinery orders on a large scale are to be placed shortly by the London and North-Eastern Railway Company, the bulk, of course, going to the Doncaster plant. At the same time, Sheffield expects to get a share, either directly or indirectly. The light foundries are getting a good deal of work in meeting the requirements of the building trade. Cast iron pipes, iron work, grates and stoves are the most active lines. In the lighter steel lines, too, there is a fair amount of activity, but competition to get business has reached a sufficiently keen point to take its toll of profits. In the agricultural and edge tool departments, there is the increasing business usually associated with this time of the year, and judging by the rate at which orders are now coming through, this seasonal trade is going to be on a larger scale than was the case last year.

### French Steel Duties.

The new French Customs Bill, details of which have been issued, will, if carried, hit the steel and hardware trades of Sheffield very heavily, and the announcement of the proposed tariffs has been received in the city with consternation. The proposed increases range from 150 to 350 per cent., and if the Bill passes, certain classes of Sheffield tools and files will be carrying duties twelve times as high as those ruling just before the outbreak of war. The tariffs, added to the influence of a depreciated currency, will make the articles sheduled far too prohibitive to be purchased by the French people. Sheffield trade with France has already suffered heavily since the war, and should the latest proposals be made law, it will disappear altogether. The Sheffield Chamber of Commerce has been in touch with Paris for some time over this matter, and the local body can be trusted to leave no stone unturned in dealing with the proposals.

### Plate and Cutlery.

There is little fresh to report in these branches this week. Trade remains lifeless, especially in the higher quality departments. In table cutlery, the chief demand is for goods of the stainless variety. The output of razors, scissors, pen and pocket knives is low, and is being chiefly sustained by a few particular markets. An increasing business is being done in safety razor blades, and the Sheffield product is rapidly getting a reputation as high as that of the much-boomed American product. The silver and best electro-plate trades are finding work difficult to get, the call in these days being mainly for the cheaper grades. It will be some weeks before one will be able to judge on what lines business will develop this year, but a general improvement in trade, giving the people of this country more money, would no doubt be reflected in the plate and cutlery industries.

### Sheffield Station Scheme.

A £36,000 scheme by the London and North-Eastern Railway Company is shortly to be embarked on at Darnall, one of Sheffield's East End stations. New station buildings, platforms and subways are to be erected, with a re-arrangement of the up and down main and down loop lines. A loop line from Woodburn to Darnall East Junction is to be made, and a cross-over road at Darnall East Junction is to be constructed, with alterations to the shunting neck of the Darnall goods yards. This scheme has nothing to do with the company's big 1925 schemes announced in December, as it is part of last year's programme.

### Electric Light in Pennyworths.

The general manager of the Sheffield Corporation Electric Supply Department—Mr. S. E. Fedden—has prepared an important scheme for the installation, on the penny-in-the-slot meter system, of electric lighting in a selected working-class district. The scheme has been got out on the following basis:—That all wiring and fittings, including first supply of lamps, should be done at the cost of the department, and that the current be supplied at a price to cover cost of current, rent of meter, interest and sinking fund on the cost of the installation. The general manager's proposal is that the Corporation should provide and fix the necessary wiring installation, consisting of five lamps of the new gas-filled 40-watt type, and provide the slot meters as suggested. The meters would be adjusted so as to cover the cost of current and the other costs indicated. The adjustments will have to be made on the basis of a sinking fund to recover the cost of the installation after the consumption of 800 units—ten years' average at 80 units per annum. At this rate, 187 minutes' use of one lamp would be obtained for one penny. After 800 units have been registered, Mr. Fedden says, the meters would be adjusted to ordinary rates then in force, and after this adjustment, one penny would provide light in one lamp for 249 minutes. The Committee has approved the scheme, the development of which will be watched with interest by those concerned in the popularising of electricity for domestic use.

### More Colliery Developments.

Extensive developments are promised in the Nottinghamshire and Derbyshire coalfield. The Cossall Colliery Company, Limited, near Ilkeston, announces that a new seam of coal has been struck at the Trowel Moor pit, and that it will provide work for many years for about 1000 men. The coal will be of a valuable quality for gas-producing and domestic purposes, and the seam will be the deepest worked in the district. It is also announced that developments are pending at Bentley Colliery, near Doncaster. The owners, Messrs. Barber, Walker and Co., are carrying out investigations on the Dunsil seam, 20 yards below the Barnsley bed.

### Extensions of Mains.

Application is to be made by the Sheffield Water Committee to the Ministry of Health for sanction to borrow £160,000 for extensions of mains and other waterworks purposes. In this is included an installation of pressure filters for utilising the second instalment of the Derwent supply, a reference to which I made last week.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### Ironworks Restarted.

THIS week Gjers, Mills and Co., Limited, resumed operations at their Ayresome Ironworks, Middlesbrough, which had been idle since September last. Two blast-furnaces have been re-kindled for the production of hematite. There are now 43 blast-furnaces operating on the North-East Coast.

### Cleveland Iron Trade.

The Cleveland pig iron market has developed a generally weaker tone. Since the beginning of the year there has been little inclination on the part of consumers to book fresh supplies. Most of them have bought well ahead, and are not inclined to commit themselves further until the outlook becomes clearer. No doubt the factor which makes most for weakness is the dearth of export orders. No. 3 foundry iron is offered at Antwerp 74s. 6d. per ton, a figure with which Cleveland cannot possibly compete, and consequently very little foreign business is coming through. However, the home trade is healthy enough. There is a gradual expansion in the volume of work placed with founders and engineers, and this insures the bulk of the output of the furnaces passing into consumption. Still, there is a surplus, and the disposal of this surplus is at the moment such a matter of difficulty that makers are inclined to cut prices. Some still ask 81s. for small lots of No. 3 G.M.B. iron, but the general market rate is 80s. 6d., and possibly even that figure could be shaded for a big order. No. 1 foundry iron is put at 85s. 6d.; No. 4 foundry, 79s. 6d.; and No. 4 forge, 79s. per ton.

### Hematite Pig Iron.

There is also a further drop in the price of East Coast hematite pig iron. Orders are very scarce, and competition keen. Some very low prices have been accepted for export orders, and as the make has been increased this week by the lighting up of two more hematite furnaces, competition is not likely to be relaxed. Makers are now prepared to sell mixed numbers at 87s. per ton, and No. 1 at 87s. 6d.

### Ironmaking Materials.

The general weakness extends also to the fuel market. Export orders are bad to find, and consequently there is more pressure to sell here. However, Durham coke makers keep the price of good medium furnace kinds at 25s. per ton delivered at the works, and 22s. 6d. per ton is also a nominal c.i.f. price for best Rubio ore, although there is no new business.

### Manufactured Iron and Steel.

There is no new development in the manufactured iron and steel trade. The slackness in the shipyards is one of the retarding influences in the trade, and the few orders recently placed for new tonnage are but a drop in the ocean. Consequently steel makers have to look in other directions for orders to employ their plant, and although they are not looking entirely in vain, the flow of orders is still very slow. Prices are unaltered.

### Shipbuilding.

The outlook in the shipbuilding trade on the North-East Coast is brightening, and there is every prospect of greater activity at the yards in the near future. A number of inquiries for new tonnage is reported to be circulating. This week Swan, Hunter and Co., Wallsend, have booked a contract for three new steamers for the Canadian Lakes. Two will be of the type recently built by the firm, and the third of a more important character. The vessels will be built at Wallsend. The Northumberland Shipbuilding Company, Limited, Howdon, has booked a contract for a new coasting steamer, with special electrical equipment, for the Union Steamship Company of New Zealand. It is understood the engines will also be constructed locally.

### Ironstone Miners' Wages Reduced.

As the result of the drop in the price of pig iron during the past quarter, the wages of Cleveland ironstone miners will be reduced by 8 per cent. for the ensuing three months, which will bring the district percentage from 78 to 70 per cent. In connection with this settlement, the owners, at the request of the men, have agreed to a slight readjustment of the arrangement come to in 1918 relating to "fours" and yardage rates, &c., but the owners stipulated that they should have the right to review this adjustment when wages are again under consideration three months hence.

### The Coal Trade.

The lack of demand in the Northern coal trade is daily becoming more pronounced, and with few orders actually being placed, the outlook is very disappointing. The slackness is surprising, as it is noticeable in all the home trades, and also from continental centres. Fitters, however, have reason to believe that merchants hold a fair number of orders, and are only putting them out for day-to-day requirements, but even under these conditions the total requirements are much below what could be dealt with, and consequently, while sellers make a hard fight against price reductions, the scarcity of business is all against a maintenance of late values, and the position this month thus becomes disappointing, and for February and onwards does not give any great encouragement. Still, fitters take a hopeful view, and anticipate a steadily increasing demand for the spring shipments. Best Northumberland steams are firm at 18s. 6d. per ton for prompt, but for next week and onwards fair supplies are available, and 18s. 3d. is indicated. The position in the Durham gas coal trade shows no development. With so little to test values, operators regard the position as weak, and press for substantial concessions in price. Fitters, however, prefer to hold on from day to day rather than discount the market. Best Durham gas is about 21s. per ton. Coking, unscreened and bunkers, are a slow trade and plentiful at 18s. to 19s. Only the best specials can improve on these figures. The demand for coke is very slow, although there is some interest in the trade shown by German buyers, but until definite business offers, prices show no movement, and, on the whole, the trend of the market for spot clearance is easier.

## SCOTLAND.

*(From our own Correspondent.)*

### Featureless Markets.

THERE has been very little, if any, fresh interest in the Scottish steel, coal or iron markets during the past week. The resumption of work since the beginning of the year has been slow, and even yet operations are not up to the standard prevailing prior to the stoppage. Outputs generally are low, and until conditions in that respect are more normal, neither sellers nor buyers are likely to show any great interest.

### Pig Iron.

The easier tone apparent in the pig iron market about the end of December last still exists. Business so far has been extremely slow, and it seems probable that the small number of furnaces in blast will be quite equal to all calls for some time to come, unless some radical change is apparent in the situation at the steel and iron works in the district.

### Steel.

There has been little indication of improvement in the demand for plates and sections. For many months back the demand from shipyards has been poor, and while makers have hopes that this will improve, there are no signs of immediate expansion. The current prices of foreign competitive materials are still likely to react considerably against home producers. Steel sheet makers, on the other hand, are busy. Orders booked before the holiday were fairly extensive on export account, while home demands now tend to open out. Prices are very firm, especially for galvanised flat and corrugated sheets.

### Bar Iron.

The majority of the bar iron works are only now getting into action, and the market has been almost devoid of interest to date. The amount of fresh business is comparatively small, but makers are more hopeful as to the near future. Prices are unchanged so far. The re-rolled steel department of the bar iron trade remains in an unsatisfactory position, and the price basis, home or export, may be calculated somewhat below £9 per ton.

### Scrap.

Although the demand for scrap material has not developed much since the restart, consumers appear more anxious to anticipate requirements over a period. Prices are firm.

### Coal.

Business in the coal market has been of a very restricted nature. The majority of the collieries are in operation, but it is said that outputs are not yet up to the standard pertaining before the stoppage. Some of the pits are working on short time, and are likely to continue to do so until a distinct improvement is noticeable in foreign demands. At the moment, the outlook is most uncertain, and, to quote some opinions, "most unsatisfactory." The market is weak at present, and it is reported that some collieries, which have been fairly well placed up till now, owing to good contracts arranged prior to the depression, have intimated that if prices fall below a certain level, which is not much below the current level, they will close down rather than sell at a loss. Reports from all districts indicate poor demands for practically all classes of fuel, and even with a fair amount of broken time at many pits, the output is apparently more than equal to all calls. Forward inquiries remain conspicuously absent. While the general tone is lower, treble nuts in particular are a very weak spot, supplies being most excessive. Approximate prices show little alteration, but there is small doubt but that a good order would receive better terms. Shipments for the past week amounted to 176,631 tons, against 136,942 tons in the preceding week and 223,134 tons in the same week last year. The home market also holds little of fresh interest. Industrial demands continue at a low ebb. House coal is fairly busy, and some of the best brands are about 2s. per ton firmer in price.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### Coal Trade Position.

ALTHOUGH irregular, the steam coal trade is this week in a better position. This is primarily due to the fact that at last, after the prolonged gales, tonnage is coming to hand and the docks show more activity. The improvement is a very welcome one, as the New Year has not opened very auspiciously, and the general demand from abroad can still only be described as quiet. No doubt, under the influence of loading pressure, values will show some tendency to become steadier, if indeed they do not advance. It all depends upon whether the present increased activity in shipments will be maintained. Doubts are entertained on this point in some quarters in view of the fact that there is no appreciable broadening in the inquiry from continental countries, but at the same time there is just the possibility that some foreign consumers may consider it advisable to take extra supplies during the second quarter of this year in case there is trouble with the miners on the question of the new wages agreement. In this event there are the prospects of last year's conditions being repeated.

### Costs of Production.

In an article by the secretary of the South Wales Coalowners' Association, it is pointed out that the statement for the September quarter, issued by the Mines Department of the Board of Trade, dealing with output, sales and costs, is of exceptional interest. Mr. Finlay Gibson recalls that when the present wages agreement was entered into the miners' leaders were warned what would be the effect, as it was pointed out that the increases in the labour costs due to the higher minimum percentage would be more severe in South Wales than in other coalfields. Comparing the net costs in September with those for the March quarter, it is shown that in South Wales there has been an increase of 1s. 8¼d. per ton, in Northumberland a decrease of 6½d. per ton, in Durham a decrease of 1¾d. per ton, and in Scotland an increase of ¼d. per ton. The effect of this unequal movement is, he says, that there has been greater contraction in the foreign demand for South Wales coals than would have been the case if the March relative costs position had been unchanged. Furthermore, the output per man shift in South Wales has been reduced to an alarming extent compared with that in the other coal-exporting districts. During the September quarter the output per man shift worked was as follows:—South Wales, 15.88 cwt.; Northumberland, 17.27 cwt.; Durham 17.07 cwt.; and Scotland, 18.52 cwt. At the same time, notwithstanding its lower output per man shift, the average earnings in the South Wales coalfield in the September quarter were higher than those paid in any of the other three coalfields, the comparative figures being as follows:—South Wales, 10s. 10½d. per man shift; Northumberland, 9s. 8d.; Durham, 10s. 1d.; and Scotland, 10s. 7½d. Mr. Gibson adds that there is no need to emphasise the moral of these figures. They show that the prejudicial effects of the wages agreement of 1924 have been more severe in South Wales than in any of the other coalfields, and probably have been the most serious of the factors that have contributed to the present depression in the Bristol Channel coal export trade.

### Miners' Shorter Week.

The Executive Council of the South Wales Miners' Federation, at its meeting on Monday, had under consideration resolutions from the Pontypridd and Rhondda No. 2 and Maesteg districts requesting that a special delegate conference should be called to discuss the question of unemployment, and also that of a five-day working week. The Council was urged to take action as a set-off to the propaganda for a reversion to an eight-hour day. The Council agreed that there were matters requiring investigation, and a sub-committee was appointed to bring up a report for submission to the Council.

### Tin-plate Conditions.

Some improvement has been shown this week in the industrial condition in the Llanelly district, where for the past month considerable unemployment has been experienced owing to the depression in the tin-plate and steel industries. Notwithstanding the improvement it is estimated that there are still about 3000 workmen on the idle list or only engaged part time. At both the local steel works additional furnaces have been lighted, and at the Llanelly Steel Company's works an additional mill was re-started on Monday morning. There has also been a resumption of work at the Wellfield Galvanising Works and at the South Wales Tin-plate Works, while arrangements are afoot for a recommencement at the Old Castle Works.

### Current Business.

The fresh demand for steam coals has been comparatively quiet this week, but the collieries are busier, for the reason that a good deal of tonnage which has been delayed recently by the bad weather has put in an appearance. Some undertakings have more steamers in dock now than they can comfortably deal with, while, on the other hand, others are short. These sudden bursts of activity are not at all liked by collieries, as they much prefer steady conditions, with a regular flow of tonnage, thus enabling them to work their pits regularly. Prices, on the whole, show no material alteration as yet so far as coals are concerned, though Monmouthshire qualities are better in tendency, as the quantity of tonnage which has gone into the Newport docks during the past few days has been fairly considerable, and vessels are waiting their turn for a berth. Patent fuel is steady and some makers are quite well stemmed. Anthracite coals are somewhat irregular, but a feature is the sharp decline in the price of pitwood. Only recently collieries were bidding over 30s. for prompt supplies of this commodity, but this week, owing to the good arrivals, prices have fallen away to 24s. 6d. to 25s.

1925 INTERNATIONAL EXHIBITION AT BASLE.—An International Exhibition dealing with inland shipping and water power undertakings is planned to be held at Basle, Switzerland, from July 1st till September 15th, 1925. The prospectus, which will shortly be issued in English, French, German, Dutch and Italian, will give full particulars of the proposed arrangements, and can be obtained on application to the secretary of the Exhibition at Basle.

THE STATUS OF ENGINEERS AND CHEMISTS.—Information regarding the status and working conditions of engineers and chemists in twenty-five different countries is contained in a new publication of the International Labour Office of the League of Nations just published—"Engineers and Chemists," International Labour Office, London Branch, 26, Buckingham-gate, S.W. 1, 1s. 6d. net. The points particularly covered in this report are (1) the meaning of the terms "engineer" and "chemist" and the methods of obtaining and protecting these titles; (2) the employment position; (3) contracts, including provisions on business secrets and unfair competition; (4) conditions of work; (5) salaries, including patent rights; (6) insurance; (7) problems of professional organisation; and (8) special points. It is interesting to note, for example, that there are thirty-one different engineering degrees and diplomas in the United States, and that new ones are constantly appearing; while, in Ecuador the Faculty of Science of the Central University of Quito grants diplomas in chemistry and engineering, the courses of study lasting four and six years respectively. The section on the employment of women states: "In no country have women as yet taken a prominent place in the chemical and engineering professions, but they do important work, more especially in pure science, teaching and in laboratory work. There are no known cases of women engineers employed in factories. They are generally held to lack the necessary authority for directing workmen. A certain number of women are, however, employed in draughtsmen's offices. In the chemical industry, similarly, hardly a single case is known of a woman being employed directly on manufacturing processes."

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| Native | 17/6 to 24/– |
| (1) Spanish | 23/– |
| (1) N. African | 23/– |
| N.E. COAST— | |
| Native | — |
| Foreign (c.i.f.) | 22/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 4 15 0 | — |
| No. 1 Foundry | 4 12 6 | — |
| No. 3 Foundry | 4 10 0 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 4 7 0 | 4 7 0 |
| No. 1 | 4 7 6 | 4 7 6 |
| Cleveland— | | |
| No. 1 | 4 5 6 | 4 5 6 |
| Silicious Iron | 4 5 6 | 4 5 6 |
| No. 3 G.M.B. | 4 0 6 | 4 0 6 |
| No. 4 Foundry | 3 19 6 | 3 19 6 |
| No. 4 Forge | 3 19 0 | 3 19 0 |
| Mottled | — | — |
| White | — | — |
| MIDLANDS— | | |
| (3) Staffs.— | | |
| All-mine (Cold Blast) | 10 10 0 | — |
| North Staffs. Forge | 3 17 6 | — |
| ,, ,, Foundry | 4 7 6 | — |
| (3) Northampton— | | |
| Foundry No. 3 | 3 16 0 to 3 17 0 | |
| ,, Forge | 3 11 0 to 3 12 0 | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 4 2 6 | — |
| Forge | 3 16 6 to 3 17 6 | |
| (3) Lincolnshire— | | |
| No. 3 Foundry | 4 2 6 | — |
| No. 4 Forge | 4 0 0 | — |
| Basic | 4 5 0 | — |
| (4) N.W. COAST— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 5 2 6 (a)<br>5 7 6 (b) | —<br>— |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 12 0 0 | — |
| Best ,, | — | — |
| N.E. COAST— | | |
| Common Bars | 12 0 0 | — |
| LANCS.— | | |
| Crown Bars | 13 0 0 | — |
| Second Quality Bars | 12 0 0 | — |
| Hoops | 15 0 0 | 14 15 0 |
| S. YORKS.— | | |
| Crown Bars | 13 0 0 | — |
| Best ,, | 13 10 0 | — |
| Hoops | 14 10 0 | — |
| MIDLANDS— | | |
| Crown Bars | 12 15 0 | — |
| Marked Bars (Staffs.) | 13 0 0 | — |
| Nut and Bolt Bars | 11 15 0 | — |
| Gas Tube Strip | 13 2 6 to 13 5 0 | — |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates | 13 0 0 | — |
| Ship Plates, ¾in. and up | 9 15 0 | — |
| Sections | 9 10 0 | — |
| Steel Sheets, 3/16in. to ½in. | 12 0 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 18 10 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 9 15 0 | — |
| Angles | 9 10 0 | — |
| Boiler Plates | 13 0 0 | — |
| Joists | 9 10 0 | — |
| Heavy Rails | 9 0 0 | — |
| Fish-plates | 13 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5 |
| Hard Billets | 9 10 0 | — |
| Soft Billets | 8 10 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 9 0 0† | — |
| Light ,, | 9 5 0 to 9 10 0 | |
| Billets | 8 0 0 to 11 10 0† | |
| MANCHESTER— | | |
| Bars (Round) | 10 0 0 to 10 10 0 | |
| ,, (others) | 9 15 0 to 10 0 0 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| ,, (Soft Steel) | 13 15 0 | 13 10 0 |
| Plates | 9 15 0 to 10 0 0 | |
| ,, (Lancs. Boiler) | 13 0 0 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 11 10 0 | — |
| Bessemer Billets | 13 0 0 | — |
| Hard Basic | 9 10 0 | — |
| Intermediate Basic | 9 0 0 | — |
| Soft Basic | 8 0 0 to 8 5 0 | |
| Hoops | 12 0 0 | — |
| Soft Wire Rods | 11 0 0 to 11 10 0 | |
| MIDLANDS— | | |
| Small Rolled Bars | 9 0 0 to 9 15 0 | |
| Billets and Sheet-bars | 7 0 0 to 7 10 0 | |
| Sheets (20 W.G.) | 11 10 0 to 12 0 0 | |
| Galv. Sheets, f.o.b. L'pool | 17 2 6 to 17 5 0 | |
| Angles | 9 5 0 | — |
| Joists | 9 5 0 | — |
| Tees | 10 5 0 | — |
| Bridge and Tank Plates | 9 15 0 | — |
| Boiler Plates | 13 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 | 23/6 to 23/7½ |
| Block Tin (cash) | 266 15 0 |
| ,, (three months) | 271 0 0 |
| Copper (cash) | 66 15 0 |
| ,, (three months) | 67 17 6 |
| Spanish Lead (cash) | 43 10 0 |
| ,, (three months) | 41 10 0 |
| Spelter (cash) | 38 13 9 |
| ,, (three months) | 38 3 9 |
| MANCHESTER— | |
| Copper, Best Selected Ingots | 73 0 0 |
| ,, Electrolytic | 73 10 0 |
| ,, Strong Sheets | 97 0 0 |
| ,, Tubes (Basis Price) | 0 1 1½ |
| Brass Tubes (Basis price) | 0 1 0½ |
| ,, Condenser | 0 1 2½ |
| Lead, English | 46 0 0 |
| ,, Foreign | 44 5 0 |

## FERRO ALLOYS.

*(All prices now nominal.)*

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 1/8½ per lb. | |
| Ferro Tungsten | 1/4½ per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £24 0 0 | 8/– |
| ,, 6 p.c. to 8 p.c. ,, | £23 10 0 | 7/9 |
| ,, 8 p.c. to 10 p.c. ,, | £23 0 0 | 7/6 |
| ,, Specially Refined | | |
| ,, Max. 2 p.c. carbon | £43 0 0 | 16/– |
| ,, ,, 1 p.c. ,, | £52 0 0 | 17/6 |
| ,, ,, 0.75 p.c. carbon | £60 0 0 | 20/– |
| ,, ,, carbon free | 1/5 per lb. | |
| Metallic Chromium | 4/2 per lb. | |
| Ferro Manganese (per ton) | £15 for home, £15 for export | |
| ,, Silicon, 45 p.c. to 50 p.c. | £11 15 0 scale 5/– per unit | |
| ,, ,, 75 p.c. | £17 17 6 scale 6/– per unit | |
| ,, Vanadium | 17/6 per lb. | |
| ,, Molybdenum | 7/9 per lb. | |
| ,, Titanium (carbon free) | 1/2 per lb. | |
| Nickel (per ton) | £165 | |
| Cobalt | 10/– per lb. | |
| Aluminium (per ton) | £130 | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 17/– |
| ,, ,, Ell | 18/6 |
| ,, ,, Splint | 19/– to 22/6 |
| ,, ,, Trebles | 18/6 |
| ,, ,, Doubles | 18/– |
| ,, ,, Singles | 14/3 |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 17/– |
| ,, ,, Splints | 19/– |
| ,, ,, Trebles | 18/6 |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 15/– to 17/– |
| Screened Navigation | 24/– |
| Trebles | 19/6 to 20/6 |
| Doubles | 18/3 |
| Singles | 14/6 |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 16/3 |
| Secondary Steam | 15/9 |
| Trebles | 19/3 |
| Doubles | 18/– |
| Singles | 14/6 |

### ENGLAND.

| | Inland. | Export. |
|---|---|---|
| (8) N.W. COAST— | | |
| Steams | | 28/6 |
| Household | | 45/– to 58/4 |
| Coke | | 30/– |
| NORTHUMBERLAND— | | |
| Best Steams | | 18/6 |
| Second Steams | | 17/6 to 18/– |
| Steam Smalls | | 10/6 |
| Unscreened | | 15/6 to 17/– |
| Household | | 23/6 to 25/– |
| DURHAM— | | |
| Best Gas | | 21/6 |
| Second | | 18/– to 18/6 |
| Household | | 23/6 to 25/– |
| Foundry Coke | | 24/– to 24/3 |
| SHEFFIELD— | | |
| Best Hand-picked Branch | 32/– to 35/– | — |
| Barnsley Best Silkstone | 26/– to 28/– | — |
| Derbyshire Best Brights | 27/– to 32/– | — |
| ,, ,, House | 24/– to 26/– | — |
| ,, ,, Large Nuts | 22/6 to 25/– | — |
| ,, ,, Small | 14/– to 16/– | — |
| Yorkshire Hards | 20/– to 23/6 | — |
| Derbyshire ,, | 19/6 to 22/– | — |
| Rough Slacks | 9/6 to 12/– | — |
| Nutty ,, | 8/6 to 10/6 | — |
| Smalls | 4/– to 6/6 | — |
| Blast-furnace Coke (Inland)* | — | — |
| ,, ,, (Export) | f.o.b. | 21/6 to 22/6 |

### (9) SOUTH WALES.

| | |
|---|---|
| CARDIFF— | |
| Steam Coals : | |
| Best Smokeless Large | 27/– to 27/6 |
| Second ,, ,, | 26/– to 27/– |
| Best Dry Large | 26/6 to 27/– |
| Ordinary Dry Large | 24/– to 25/– |
| Best Black Vein Large | 24/6 to 25/– |
| Western Valley ,, | 23/6 to 24/6 |
| Best Eastern Valley Large | 23/6 to 24/6 |
| Ordinary ,, ,, | 22/6 to 23/– |
| Best Steam Smalls | 16/– to 16/6 |
| Ordinary ,, | 13/– to 15/– |
| Washed Nuts | 22/– to 32/– |
| No. 3 Rhondda Large | 27/– to 27/6 |
| ,, ,, Smalls | 10/– to 20/– |
| No. 2 ,, Large | 22/6 to 23/6 |
| ,, ,, Through | 18/– to 20/– |
| ,, ,, Smalls | 11/– to 13/– |
| Foundry Coke (export) | 40/– to 47/6 |
| Furnace Coke (export) | 27/6 to 32/6 |
| Patent Fuel | 25/– to 27/– |
| Pitwood (ex ship) | 24/6 to 25/– |
| SWANSEA— | |
| Anthracite Coals : | |
| Best Big Vein Large | 45/- to 47/6 |
| Seconds | 36/6 to 37/6 |
| Red Vein | 32/6 to 35/– |
| Machine-made Cobbles | 50/– to 55/– |
| Nuts | 55/– to 60/– |
| Beans | 44/– to 45/– |
| Peas | 20/– to 23/– |
| Breaker Duff | 9/– to 9/6 |
| Rubbly Culm | 10/– to 10/6 |
| Steam Coals : | |
| Large | 24/6 to 25/6 |
| Seconds | 22/6 to 24/6 |
| Smalls | 14/– to 16/– |
| Cargo Through | 17/– to 19/– |

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/– at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

# French Engineering Notes.

(*From our Correspondent in Paris.*)

### Finance and Trade.

THE industrial situation is at a deadlock. The refusal of the Germans to accept a *modus vivendi* arrangement has seriously complicated things, since Germany is now practically closed to French products, and the Lorraine iron and steel firms will have to look to the home market, which has already a surplus of material, and it is difficult to see how the heavy supplies of iron and steel from the restored province can be absorbed. The fear of internal competition is leading makers to believe that something must be done to regulate production, on the lines presumably of the proposal discussed during the recent Franco-German negotiations, the failure of which was one of the reasons for the falling through of the treaty of commerce. There is still hope that the negotiations for a treaty will be resumed shortly and be carried through rapidly to a satisfactory conclusion, but as the Germans have imposed the condition that they must be accorded the most favoured nation treatment the outlook is by no means reassuring. The French Government declares that it is beyond its power to grant Germany the most favoured nation treatment. If it had the power, and the privilege were accorded, it would mean the ruin of many French industries. Apart from this element of unrest the financial conference is regarded as a factor of instability to trade, for should the French fail to obtain satisfaction and be obliged to fulfil partially their financial obligations, it will be necessary to impose further burdens upon industry, which already finds production costs steadily increasing.

### The Naval Programme.

The new Bill which has been presented to the Chamber of Deputies fixing the composition of the navy differs from the previous Bill only in the larger number of submarines. The present tonnage of capital ships is 117,500 tons, and there is no intenetion during the next four years to increase it, although the question may arise at some future date of bringing the tonnage up to the 175,000 tons allowed by the Washington Conference. Meanwhile, building activity will be centred entirely upon 360,000 tons of cruisers, destroyers and torpedo boats. Of submarines the tonnage has been increased from 65,000 tons to 96,000 tons. During the next four years it is proposed to put upon the stocks four cruisers, fifteen destroyers, thirty-six submarines, two minelayers, four tank steamers, and a seaplane transport.

### A Psycho-technical Laboratory.

The company working the omnibus and tramway services in Paris has had the idea of applying to the selection of its drivers the same methods that are employed in the Air Force for determining the capability of pilots. What is known as a psycho-technical laboratory has been created with a complete equipment of electrical and mechanical appliances for recording the reflex actions of candidates; that is to say, the nervous impulses that take place in moments of emergency. When a record has been taken of a man's nervous temperament he is placed on a driving platform and a film gives him the illusion of driving in the street with all sorts of obstacles and dangers that he may encounter in actual service. His instinctive movements are recorded to show his state of impressionability. It is only when a man is judged to possess the coolness and promptitude required to make a good driver that he is placed on a car or omnibus to learn the art of driving.

### Railway Electrification.

The electrification of the Paris-Orleans Railway is so far advanced that the service will be inaugurated this year with an American type of locomotive which is reported to have attained trial speeds in the States of 109 miles an hour. On the French line it will not exceed the regulation limit of 74½ miles an hour. Between Paris and Châteauroux the energy will be supplied by the Gennevilliers power station and by the Eguzon hydro-electric installation on the Creuse where the barrage, 58 m. high and 250 m. long, will be entirely completed in five or six months' time. It will have five turbo-alternators of 10,000 kilowatts. Between Châteauroux and Toulouse the energy will be provided by the hydro-electric stations of Coindre on the Chavanan and of the Cellette on the Rhue. They are expected to be completed by the end of 1926. The mains to transport the energy have already been laid between Eguzon and Les Aubrais, and electric trains will be running between Paris and Orleans during the second half of the year.

### The Russian Fleet.

A commission from the Soviet Government has visited Bizerta to inspect the fleet which sought refuge in that port after the defeat of General Wrangel. It was stated some time ago that the French Government had kept the vessels in good condition and that while some were obsolete others were, nevertheless, serviceable as fighting units. It was suggested even that if the vessels were handed over to the Soviet they would enable the Russians to have entire control of the Black Sea. When the French recognised the Soviet Government the latter claimed the restitution of the fleet, which obviously could not be handed over until the Soviet had reimbursed the French Government for the expense incurred in maintaining the fleet. It is now stated that the Russian commission has concluded that it is not worth while to send the fleet back to Russian ports, and it is probable that the vessels will be sold.

### Coal Production.

The output of the French collieries during the first eleven months of 1924 was 41,104,152 tons. The daily output of the collieries, excluding those of Lorraine, is only slightly below the figure for 1913 and, including Lorraine, the daily total during November was 153,113 tons, as compared with an average of 136,147 tons in 1913. The number of hands employed for the production increased from 203,208 in 1913 to 306,252 in November last.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

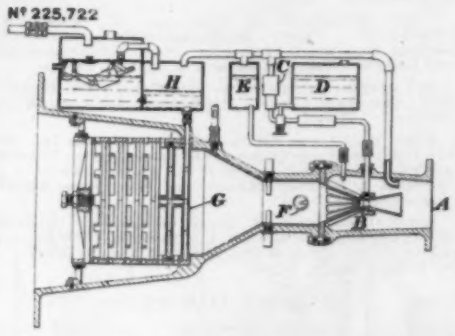
*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## STEAM GENERATORS.

225,722. January 12th, 1924.—DIRECT CONTACT STEAM GENERATORS, G. S. Dawe, 34, Beaumont-road, Plymouth, and E. W. Moon, 3, Wolseley-terrace, Mutley, Plymouth.

In this steam generator the water is evaporated by direct contact with the products of combustion. Compressed air is supplied at A, and oil fuel is delivered to the burner B by the

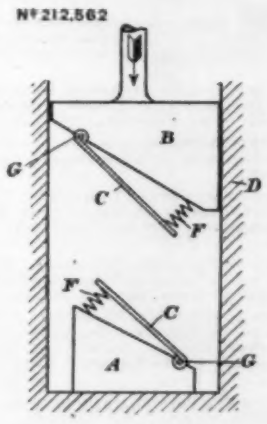



pump C sucking from the tank D. E is a supply of petrol for starting purposes, and F is a sparking plug. The products of combustion expand in the conical casing, and impinge on fine jets of water issuing from perforations in a grid of tubes G. The water is supplied from a float-controlled feed tank H. The mixture of gases and steam is discharged at the end of the casing.—*December 11th*, 1924.

## SWITCHGEAR.

212,562. March 5th, 1924.—IMPROVEMENTS IN SPRING CONTACT DEVICES FOR ELECTRICAL SWITCH APPARATUS, Brown, Boverie et Cie., Baden, Switzerland.

One of the greatest difficulties in the construction of electrical apparatus lies in the provision of satisfactory contact surfaces for switching apparatus for high intensity current. The contact pieces of such switching apparatuses are usually pressed together by springs, but since the springs cannot act uniformly at all points of the surfaces, actual contact for conducting the current will take place generally only at one point, and, at best, at a few points of the contact surface. According to this invention, the entire contact surface is utilised positively for making contact. This is effected by arranging flat machined contact surfaces parallel to one another, but oblique to the

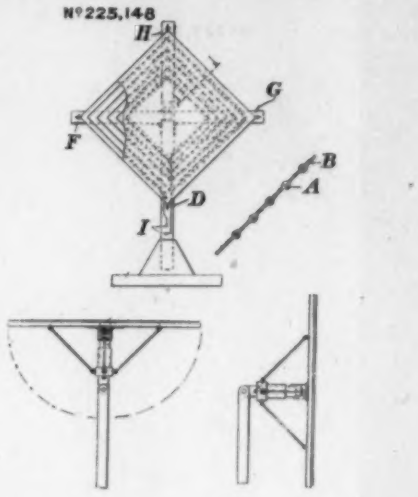



switching movement, and fastening them at their roots to their supports or carriers in such a manner as to be capable of rocking or bending, and adapted to be pressed together at their free ends in a springy manner. As shown in the accompanying illustration, flat contact plates C are connected by means of pivotal joints G to two oppositely arranged blocks A B, which are cut off obliquely to the direction of the switching movement. The free ends of the contact plates C are pressed by springs F away from the inclined surfaces of the blocks A B. The movable block B is adapted to be pushed up and down in the guideway D for the purpose of opening and closing the contacts C. The contact plates are pressed with increasing force against one another over their entire length with the compression of the springs F.—*December 11th*, 1924.

## TELEGRAPHS AND TELEPHONES.

225,148. June 27th, 1924.—IMPROVEMENTS IN LOOP AND FRAME AERIALS FOR WIRELESS SIGNALLING, Rodo Patents, Limited, of 15, Grape-street, London, W.C. 2, and Frederick Arnold Louis Sloot, of 5, Dulverton Mansions, Gray's Inn-road, W.C. 2.

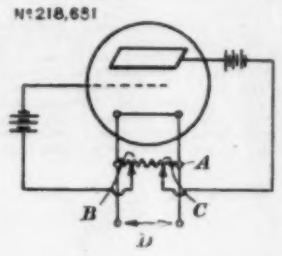
The frame aerial described in this specification comprises a vertical post D, which carries at its upper end hinged limbs F, G and H, all of which can be folded to positions parallel with the post. In extending the frame the limbs F and G are swung outwardly to positions where they are horizontally in line, whilst the limb H is turned about its hinge upwardly until vertical and in line with the post D. Terminal posts I may be provided upon the post. The aerial supporting frame may in some instances be constructed with limb members folding in the manner of umbrella ribs, as illustrated in the lower left-hand drawings, in which case it may not be necessary to detach the aerial wire A and fabric B when collapsing the frame.




The wire may be interposed between two strips of fabric stitched together.—*November 27th*, 1924.

218,681. July 5th, 1924.—IMPROVEMENTS IN AND RELATING TO CIRCUIT ARRANGEMENTS EMPLOYING THERMIONIC VALVES, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych.*

The object of this invention is to eliminate disturbances in the plate circuit of thermionic valves when alternating current

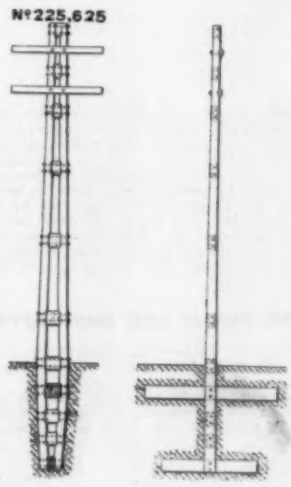



is used for heating the filament. A potentiometer A, or an auto-transformer is utilised for supplying current to the filament, the ends of the transformer being connected to the ends of the filament. B and C are adjustable taps to which the plate and grid are connected, as shown, the supply mains being connected to the terminals D. The theory of the scheme is explained.—*November 27th*, 1924.

## TRANSMISSION OF POWER.

225,625. September 6th, 1923.—IMPROVEMENTS IN POLES FOR SUPPORTING OVERHEAD ELECTRIC CONDUCTORS AND THE LIKE, The British Electrical and Allied Research Association and Edmund Basil Wedmore, of 19, Tothill-street, Westminster.

This invention relates to wooden poles such as are used for supporting overhead electric conductors. The poles are of the composite type with two longitudinal members braced together,




with spacing blocks between them, the blocks being recessed to accommodate the poles. When such poles are put under stress, the parts placed under compression are liable to fail before those under tension, owing to the liability of the wood to resist tensile stresses which are in excess of those in compression. According to the invention, the two longitudinal members of the pole are put under initial stress in opposite directions by bowing them away from each other in the manner shown.—*December 8th*, 1924.

225,761. March 27th, 1924.—FLUID-TIGHT NUTS AND ROLLING PISTONS, *Vickers Limited, Vickers House, Broadway, Westminster.*

The subject of this invention is a method of producing helically shaped profiles in fluid-tight nuts and rolling pistons for rotary machines, such as motors, pumps and compressors, such machines being of the kind in which there is arranged excentrically in an internally screw-threaded member—for the sake of brevity termed a nut—a screw of an external diameter smaller than the internal diameter of the nut, with which it engages, so that it acts as a rolling piston, the space between the screw and the

nut being filled by a trough-like member in which the screw is rotatably mounted. According to the present invention, a milling cutter or grinding disc is placed obliquely to the axis of the blank for the production of the nuts and rolling pistons,

Nº 225,761

one or both edges of this cutter being formed to correspond with the packing profile of the rolling piston, while its external surface is concave, so that a cylindrical or conical core is produced on the blank. The general form of the cutter and its work are shown in the illustration.—*December 11th*, 1924

### MEASURING AND TESTING INSTRUMENTS.

225,035. November 1st, 1923.—A BOILER LEVEL INDICATOR, G. and J. Weir, Limited, Cathcart, Glasgow, and the Right Hon. W. Douglas.

According to this invention a tube, preferably of steel, is connected to the boiler above and below the maximum and minimum water levels. Between the levels which it is desired to indicate, the tube is surrounded by a hermetically sealed jacket containing water or other suitable fluid. The jacket is arranged to have a considerable radiating surface by means of fins or corrugations. A pressure gauge is connected—say, by a tube—to the hermetically sealed space between the tube and the jacket. Owing to the differential heat transmission

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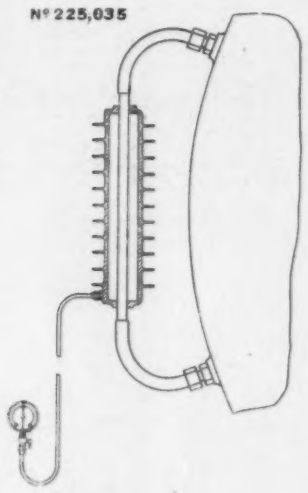

conditions when the tube is filled with steam or with water, the temperature of the fluid in the space between tube and jacket, and consequently its pressure, will depend on the ratio of the amounts of the internal surface of tube in contact respectively with water and steam. Consequently the pressure gauge will give a reading dependent on the water level in the tube. It can be calibrated accordingly. The gauge may be placed in any convenient position. If desired, the pressure in the space between tube and jacket can be used at the same time to operate a boiler feed-water regulator and/or low and high-water alarums or other devices dependent on the level of water in the boiler.—*November 27th*, 1924.

### MACHINE TOOLS AND SHOP APPLIANCES.

225,726. January 21st, 1924.—CENTRIFUGAL CASTING MACHINES, *H. G. C. Fairweather*, 65, *Chancery lane, London, W.C.* 2.

In this centrifugal casting machine both the mould and the pouring spout are water cooled. The coil for cooling the mould is shown at A, while the pipes B are used for cooling the spout

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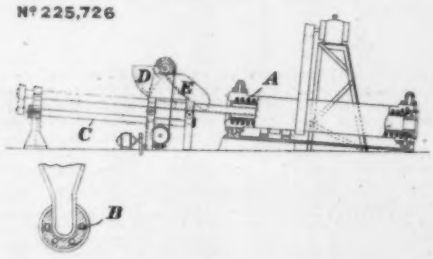



and also for holding its liming blocks in place. The spout is slid into the mould by means of the hydraulic ram C and the molten metal is poured from the tilting ladle D down the shoot E into the spout. The shoot E is fixed and consequently scrapes the spout clean as it is moved by the ram.—*December 11th*, 1924.

## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### TO-DAY.

CHEMICAL ENGINEERING GROUP.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with the Society of Chemical Industry. Discussion on "The Low-temperature Treatment of Bituminous Materials." 8 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "Alloys and their Properties," by Professor C. A. Edwards. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Transportation in Engineering Works," introduced by Mr. W. S. Crabtree. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Hexaphase System and the Compensated Three-phase System for 150,000 Volts Transmission with Records of Test," by Major A. M. Taylor. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Manchester. Paper, "Pulverised Fuel," by Mr. R. Jackson. 7.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Armstrong College, Newcastle-on-Tyne. Joint discussion with the Student Section of the Institution of Electrical Engineers on "Steam *versus* Electrical Auxiliaries." 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Investigation of the Properties of Thin Films by Means of X-rays," by Sir William Bragg. 9 p.m.

### SATURDAY, JANUARY 17TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH. JUNIOR SECTION.—College of Technology, Manchester. Lecture, "Moulding a Large Fly-wheel," by Mr. J. G. Robinson. 7 p.m,

### MONDAY, JANUARY 19TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Hydraulic Machine Tools and Power-saving Appliances," by Mr. G. Bull. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Informal meeting of Loughborough Graduates. Papers on the Motor Show will be read and discussed. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "Low-pressure Pneumatic Tires," by Mr. Colin Macbeth. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' meeting. "Turbo-blowers," by Mr. A. J. D. Humby. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-WESTERN SECTION.—Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. "Confectionery Machinery," by Mr. J. Prior. 7.15 p.m.

### TUESDAY, JANUARY 20TH.

ASSOCIATION OF DROP FORGERS AND STAMPERS.—Chamber of Commerce, New-street, Birmingham. Lecture, "Measurement of Temperature in Industrial Operations," by Dr. C. M. Walter. 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower-hill, London, E. 1. "Oil Fuel Burning in Steam Generator and Furnace," by Engineer-Lieutenant A. Marsden. 6.30 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Lecture, "Principles Governing Railway Rates," by Mr. Roger Gibb. 5.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Coventry Graduates' visit to the works of Morris Engines, Limited, Gosford-street, Coventry.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—The Engineers' Club, Queen's street, Wolverhampton. Paper, "Low-pressure Pneumatic Tires," by Mr. Colin Macbeth. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENT SECTION.—Technical College, Bradford. Address by the Chairman of the Centre, Mr. T. B. Johnson. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Lecture and demonstration of "Electric Cooking," by Miss Kennedy. 7.30 p.m.

### WEDNESDAY, JANUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "Steering," by Mr. J. G. Sheriffs. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Students' meeting. Lecture, "The Constructional Engineering of Aircraft," by Mr. R. K. Pierson. 6 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Instruments and Gauges," by Mr. H. A. Randall. 7.30 p.m.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. "Matter and Radiation," by Sir Oliver Lodge. 6 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, London, S.W. 7. Annual general meeting. Presidential address, "The Present Position of Meteorology and Meteorological Knowledge," by Mr. C. J. P. Cave. 7.30 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, London, W. 1. Annual meeting. Presidential address, "The Yeasts: A Chapter in Microscopical Science," by Mr. A. Chaston Chapman. 7.30 p.m.

SOCIETY OF GLASS TECHNOLOGY.—English Lecture Theatre of the University, Edmund-street, Birmingham. Papers, "A Note on New Ideas for Tank Furnace Design," by Mr. T. Teisen, and "Some Recent Developments in Furnaces and Gas Producers for Glass Works," by Mr. J. S. Atkinson. 2.30 p.m.

### THURSDAY, JANUARY 22ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Training School of Vauxhall Motors, Limited, Luton. Luton Graduates' meeting. Paper, "Carburation," by Mr. A. C. Saward. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Students' meeting. Discussion on "Concrete: Its Practical Use and Limitations," opened by Mr. H. C. Toy. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. "The Design of Electrical Plant Control Gear and Connections for Protection against Shock, Fire and Faults," by Mr. H. W. Clothier. 6 p.m.

MANCHESTER UNIVERSITY ENGINEERING SOCIETY.—College of Technology, Manchester. Paper, "Locomotive Construction and Maintenance," by Mr. C. J. Tirrell. 5.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, Piccadilly, London, W. 1. Lecture, "Some Recent Work of the Aerodynamics Department, National Physical Laboratory," by Major R. V. Southwell. 5.30 p.m.

### FRIDAY, JANUARY 23RD.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Reports to the Cutting Tools Research Committee: "Flow and Rupture of Metals during Cutting," by Dr. W. Rosenhain and Mr. A. C. Sturney; and "An Experimental Study of the Forces Exerted on the Surface of a Cutting Tool," by Dr. T. E. Stanton and Mr. J. H. Hyde. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "Boiler-house Records and their Practical Value," by Mr. R. H. Parsons. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Lecture Hall of the Literary and Philosophical Society, Newcastle-upon-Tyne. Lecture on "Railway Electrification in Switzerland," by Mr. E. A. Eborall. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Science and the Cotton Industry," by Dr. A. W. Crossley. 9 p.m.

### SATURDAY, JANUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the works of A.C. Cars, Limited, Thames Ditton. 2.30 p.m.

### MONDAY, JANUARY 26TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Graduates' cinema evening. 7.30 p.m.

UNIVERSITY COLLEGE, LONDON, ENGINEERING SOCIETY.—University College, London. Annual dinner.

### TUESDAY, JANUARY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Paper. "A Review of the Rating Question," by Mr. A. E. Berriman. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Graduates' meeting. Paper, "Gearing," by Mr. L. Jefferies. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Papers: "The Southampton Floating Dock," by Dr. E. H. Salmon; and "Southampton Floating Dock: Subsidiary Works," by Mr. F. E. Wentworth-Sheilds. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Great Hall, The University, Leeds. Faraday Lecture, "World-wide Radio Telegraphy," by Professor G. W. O. Howe. 7.30 p.m

### WEDNESDAY, JANUARY 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Birmingham Graduates' visit to the works of British Timken, Limited, Ward End. 2.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Milton Hall, 244, Deansgate, Manchester. Paper, "The Respective Spheres of Petrol, Steam and Electric Commercial Vehicles," by Mr. W. D. Williamson. 6.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Paper, "Studies in Filtration," by Messrs. B. W. Clarke, S. G. M. Ure, and J. W. Hinchley. 8 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, London, W. 1. Discussion, "The Use of the Microscope in the Dairying Industry. 7 p.m.

### FRIDAY, JANUARY 30TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "Notes on High Voltage Electrical Transmission," by Mr. E. Ambrose. 7.30 p.m.

### SATURDAY, JANUARY 31ST.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Guildhall, York. Quarterly meeting of the Yorkshire District. 2.30 p.m.

## CONTRACTS.

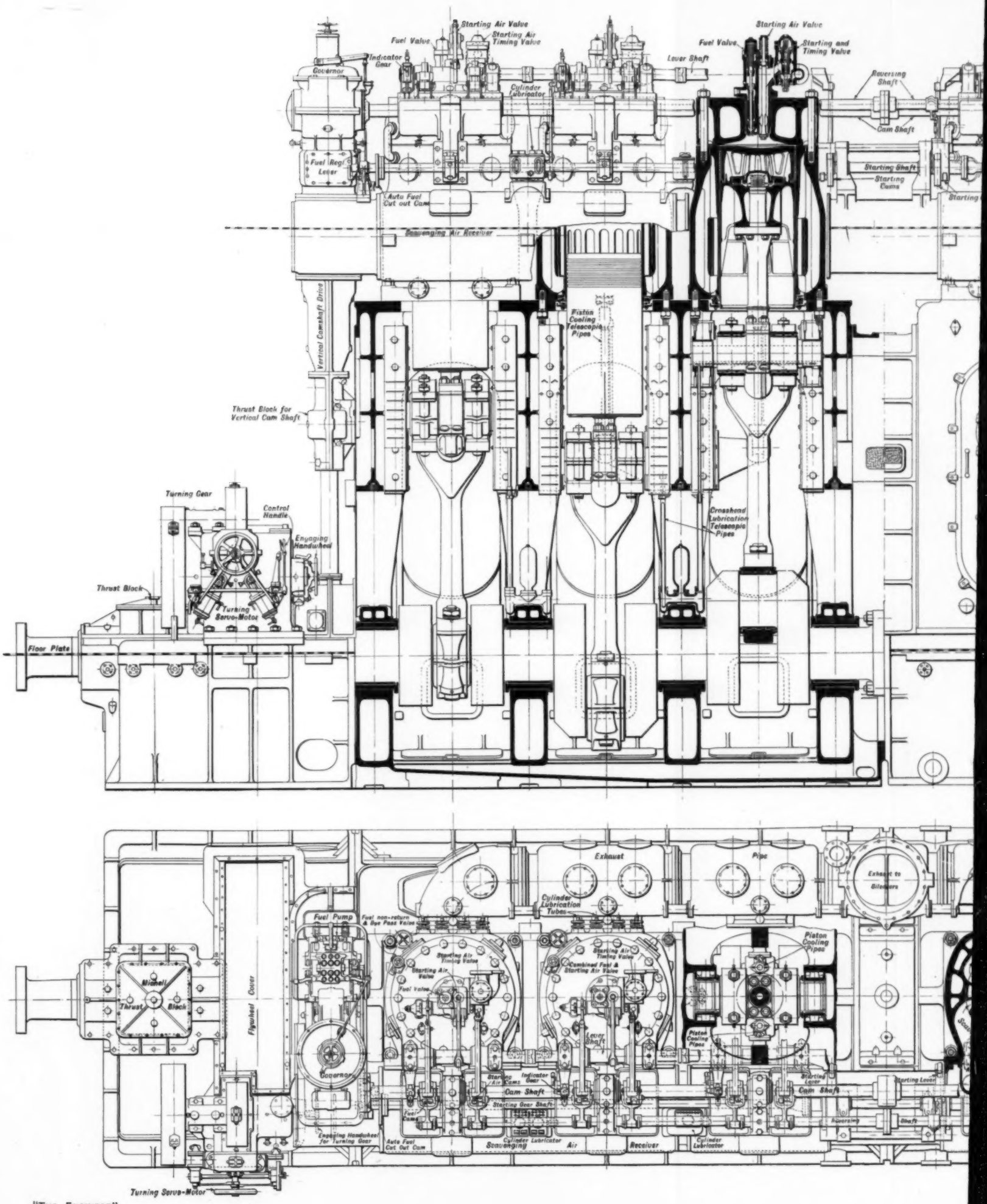
J. BLAKEBOROUGH AND SONS, Limited, of Brighouse, Yorks., have received an order for three Larner-Johnson valves for the Arapuni, N.Z., hydro-electric power scheme. The valves will be 12ft. in diameter at the inlet and 9ft. at the outlet, 20ft. 3in. in length overall, and will each weigh approximately 65 tons.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), Limited, has received an order to supply three H-L. air preheaters for the Inveresk Paper Mill Company, Limited, Musselburgh. The total heating surface of these preheaters is to be 80,040 square feet, and air is to be supplied to the furnace at about 350 deg. Fah.

WE understand that the contract for the electrical equipment of the rolling stock required for the electrification of the suburban lines of the South African Railways in the neighbourhood of Cape Town has been awarded to the English Electric Company. The lines to be electrified are those from Cape Town to the naval port of Simonstown and the seaside resorts of Kalk Bay and Muizenberg on False Bay, and from Cape Town to Sea Point. The contract is of the value of between £300,000 and £400,000, and includes electrical equipment of eighty-three motor coaches and one hundred and thirty-three trailer coaches, to be operated on a 1500-volt direct-current system. The control gear is the "English Electric" standard type, which has already been adopted by a great number of other railways, including the Great Indian Peninsula Railway and the Japanese Government Railways.

# QUADRUPLE-SCREW MOTOR LINER A

THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, LI




"THE ENGINEER"

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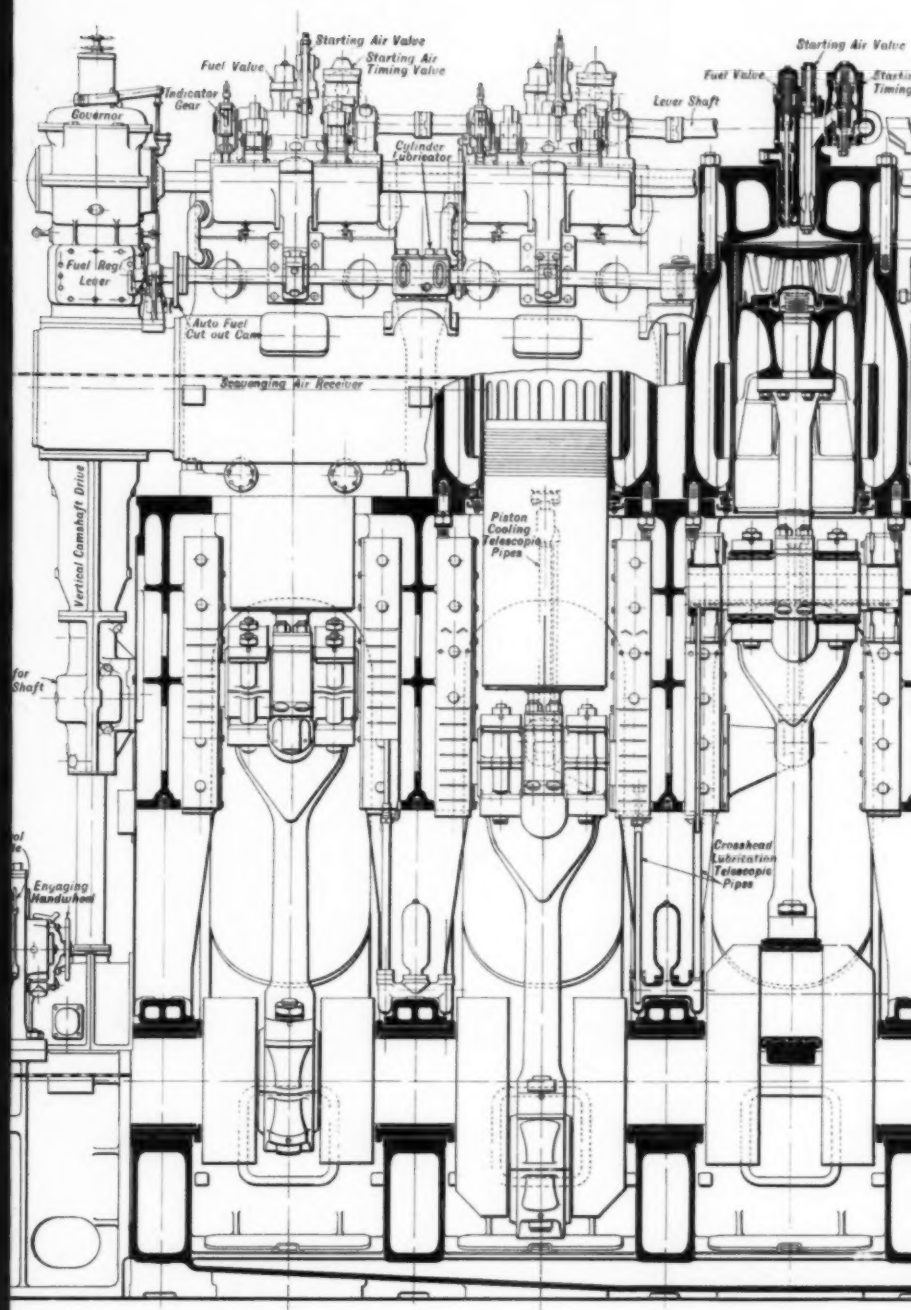
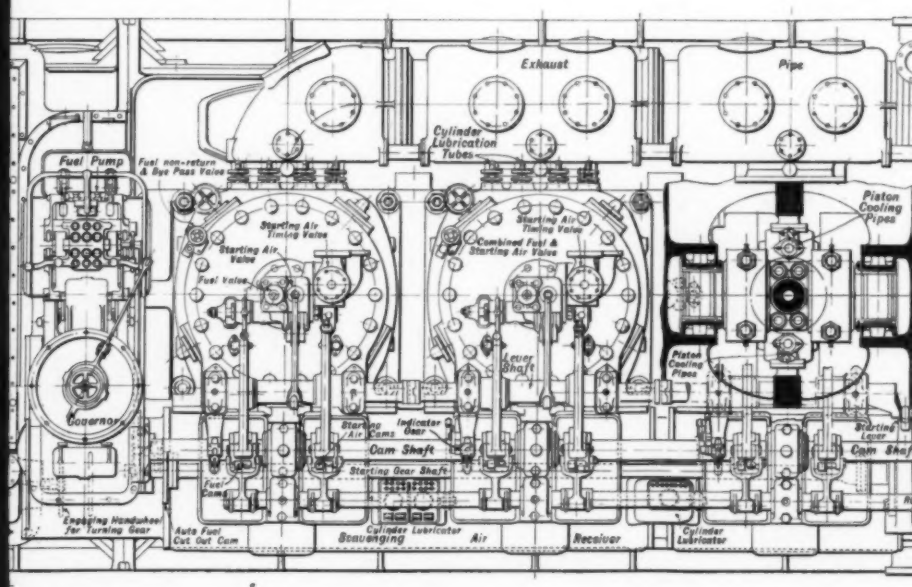
# QUADRUPLE-SCREW MOTO

THE FAIRFIELD SHIPBUILDING AND ENGIN



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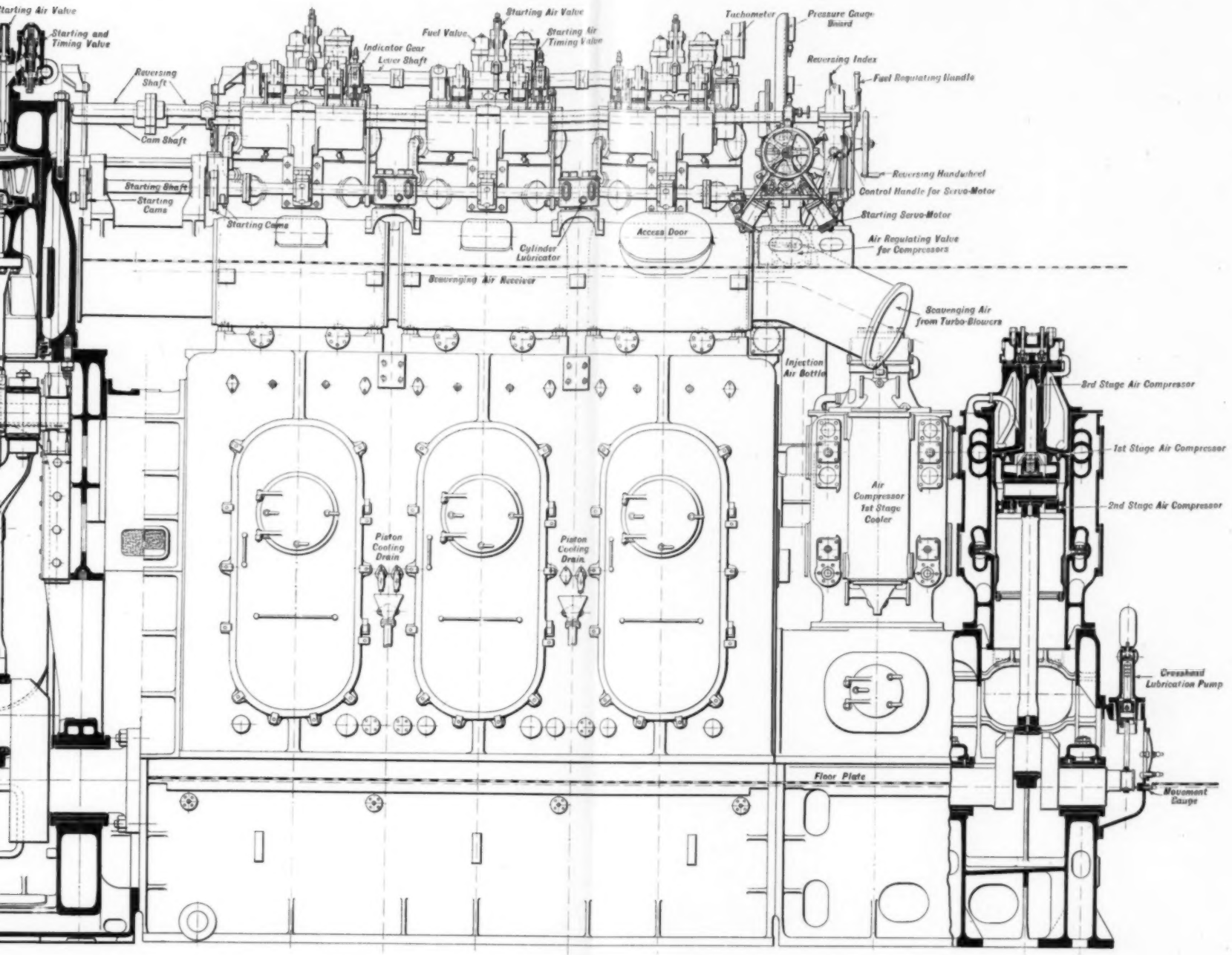
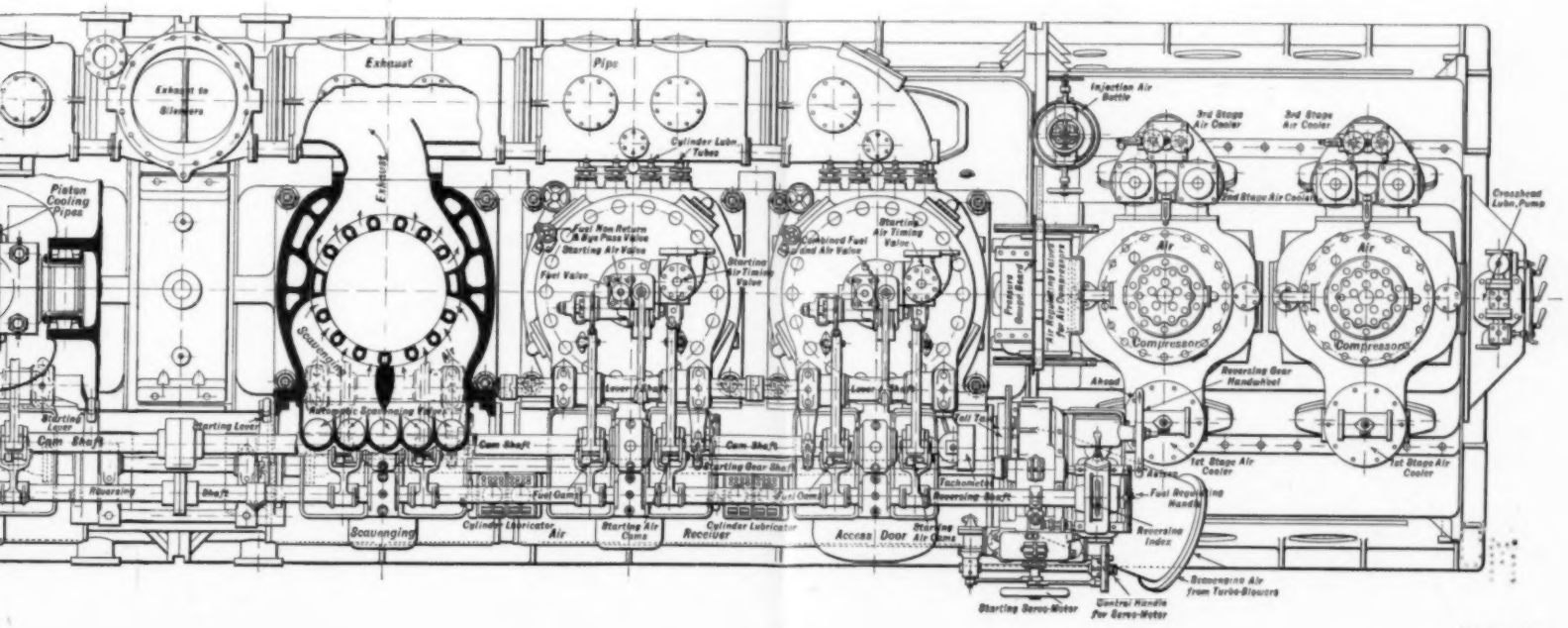
ID ENGINEERING COMPANY, LIMITED, GOVAN, GLASGOW, ENGINEERS




SWAIN Sc.